ILLINOIS STATE GEOLOGICAL SURVEY ANNUAL REPORT

July 1, 1993 – June 30, 1994

Illinois Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION

ANNUAL REPORT TO THE BOARD OF NATURAL RESOURCES AND CONSERVATION

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THE CHALLENGE — GEOLOGICAL RESEARCH AND SERVICE FOR THE PEOPLE OF ILLINOIS

Stability was achieved during fiscal year 1994 because the appropriation enacted by the General Assembly provided a modest increase for salaries. A transition has also been occurring at the Illinois State Geological Survey since November 30, 1993, when Dr. Morris W. Leighton, Chief since September 16, 1983, announced his intention to retire on August 31, 1994. The Board of Natural Resources and Conservation began the search for a successor shortly after Dr. Leighton's announcement, and it is expected that the new Chief will be selected during FY 1995. This annual report represents the final account of the achievements of ISGS staff under Chief Leighton's leadership.

Early in his tenure, Dr. Leighton developed a statement of the ISGS mission and goals:

> The Survey's functions of conducting basic and applied research, collecting and managing geological data, and performing a variety of services for the public have two major goals—to strengthen the state's economy by encouraging the exploration for, and the logical development and wise use of the state's vast mineral resources, and to improve the quality of life for Illinois' citizens by providing them with the geological information they need to develop and carry out sound environmental policies.

Former Chief Leighton (left) and Jonathan H. Goodwin, Acting Chief, highlight ISGS achievements of FY 1993.

The research and service activities summarized in this volume clearly demonstrate the breadth and depth of the Geological Survey's work toward these major goals this year.

Achievements

Coal Large reductions in the amount of coal being mined in Illinois would significantly harm the State's economy, especially that of the southern counties. Markets for Illinois' abundant coal resources face threats on several fronts. The 1990 amendments to the Clean Air Act are expected to reduce demand for the state's coal because much of it is relatively high in sulfur, contains trace elements that are the precursors of "hazardous air pollutants," and contains chlorine that can corrode boilers. Illinois coal also is more costly to mine than some competing coals, for a variety of reasons. To help the state confront these major economic and environmental issues, ISGS scientists and engineers have been

- continuing development of the high-surface-area hydrated lime material and process to efficiently remove sulfur from combustion gases.
- encouraging introduction of the integrated gasification combined cycle technology for electricity generation because it works well with the high-sulfur coals of the Illinois Basin.
- studying how the chlorine occurs in Illinois coal and showing that it apparently is released during combustion in a way that prevents or reduces the potential for boiler corrosion.

- investigating how physical coal cleaning reduces trace elements identified as potential air pollutants in coal.
- developing ways of pelletizing fine coal using sulfur-absorbing lime as a binder to make a clean-burning fuel from coal that was once wasted.
- investigating ways of making new high-value materials such as carbon molecular sieves and carbon-based catalysts from Illinois coals.
- leading the mine subsidence research program intended to help coal companies reduce potential impacts of higher efficiency mining techniques that remove more coal but cause planned subsidence of the surface—subsidence that may reduce agricultural yields and damage structures.

During his 11 years as Chief, Brud Leighton rarely missed any of the four yearly field trips conducted by ISGS geologists for the public. He enjoyed trekking over Illinois terrain with fellow scientists, teachers and their students, and nature lovers from all walks of life.

- in cooperation with the Indiana, Kentucky, and U.S. Geological Surveys, developing a project to characterize the major, minor and trace element chemical composition and other characteristics of the major coals in the Illinois Basin so that those with lowest potential for pollution can be located.
- also in cooperation with the U.S. Geological Survey, conducting studies to determine the effects of technical factors such as roof and floor conditions, overburden thickness, size of mining block and other aspects that can reduce the amount of coal that may ultimately be available for mining.

Agriculture More than 74% of the state's total area is occupied by farm land and average crop yields in Illinois are among the highest in the world. To maintain these high yields, however, farmers use large quantities of fertilizers and pesticides, chemicals that have been shown to damage the environment when improperly handled or accidentally spilled. Policies intended to reduce the potential for both point-source and nonpoint-source pollution by agricultural chemicals must be neither more stringent than necessary to do the job nor more lenient than is prudent. To help state and local officials devise policies that will protect the environment and the health of the state's economy, ISGS scientists have been

- developing new statewide and county-scale maps, such as the *Aquifer Sensitivity to Contamination from Pesticide Leaching* and *Aquifer Sensitivity to Contamination from Nitrate Leaching*, which show the likelihood for nonpoint contamination of aquifers lying within 50 feet of the surface.
- investigating the effects of soil macropores such as root tubules, animal burrows, and desiccation cracks on the movement of pesticides downward through the soil and into the groundwater system.
- assessing the fate of atrazine and other chemicals in the parking lot fill materials at agrichemical distribution centers.
- studying whether the summer floods of 1993 transported significant quantities of agricultural chemicals in parking lot fill materials away from distribution centers.
- testing the ability of white rot fungus to degrade atrazine.
- participating in development of pesticide-spiked soil materials for use in standardizing and comparing analytical results from different laboratories.
- on the basis of the studies, advising state officials on appropriate clean-up objectives for various pesticides in various situations.

Earthquake Hazard Assessment To help state and local officials understand the potential risks from a major earthquake in southern Illinois and realistically prepare for the possible economic and environmental consequences of such an event, scientists

- used structural geology and known historical events to establish the location and magnitude of a model earthquake event. On this basis, they predicted responses of geological materials to the event in relation to known locations of important facilities, then developed realistic scenarios for a 16-county region in southern Illinois for an earthquake exercise conducted by the Illinois Emergency Management Agency on May 25, 1994.
- are working in cooperation with the Geological Surveys of six other states of the Central United States Earthquake Consortium to compile a regional earthquake hazard map.
- have mapped faults in the Reevesville and Mermet Quadrangles that apparently provide the first evidence ever found in Illinois of faulting in rocks younger than the Cretaceous Period (about 65 million years old) and are preparing to map a broader area for the purpose of locating additional faults and evidence that might be used to estimate the recurrence interval for major seismic events in southern Illinois.
- completed the final report for a survey of landslides along the bluffs of the Mississippi and Ohio rivers that showed that many of the landslides probably were earthquake-induced.
- are planning, in cooperation with the U.S. Geological Survey and the members of the Illinois Basin Consortium, to compile a seismotectonic map for the Wabash Valley Seismic Zone.

Expanding Databases In addition to conducting scientific investigations applied to specific issues of economic development or environmental protection, ISGS scientists also compile, organize, and interpret data and conduct fundamental research projects to provide the foundations needed to respond quickly and accurately to inquiries from the general public, industry, and local, state, and federal officials. Time and again, when emergencies such as the Great Flood of 1993 or the flooding of the merchant tunnels in Chicago have threatened the state's economic and environmental health, the Illinois State Geological Survey has been there—responding quickly and effectively, drawing upon the expertise of its staff and comprehensive files of data to advise state and local officials on the geological aspects of the problem at hand.

Earth and its environments must be recognized as dynamic, evolving, and subject not only to gradual changes, but also to disasters or catastrophic changes.

Many economic and environmental issues now confronting the State have no easy answers. Data in ISGS files often are not sufficiently detailed, or they must be reinterpreted and manipulated by our experts, to respond to the kinds of questions being asked. For example, most of Illinois still has not been geologically mapped at the detailed scale now required. Comparatively few records for the hundreds of thousands of water wells, oil wells, engineering test borings, and other holes drilled in Illinois have been reviewed and interpreted by geologists. Even though the geology of an area has been mapped, or one or more drill holes have been examined, the data needed to respond to the current question may not be available. Indeed, the present question may have been inconceivable at the time the earlier study was made.

As Dr. Leighton observed in his message to the Board for the August 1994 meeting, the term "ecosystem management" is currently being applied, at state and federal levels, to regulatory and other practices intended to promote a holistic, complete-system approach to conservation and management of natural resources. One goal of this

approach is to develop a sufficient understanding of the interrelationships among biological systems and the impacts of humans upon those systems so that the correct measures can be taken to conserve our natural resources, protect the environment from damage, and avoid long-term repercussions on humans. From the point of view of geologists, however, the approaches to ecosystem management currently under discussion, for the most part, are ignoring the strong influences of geological, atmospheric, and hydrologic systems on the long-term stability of biological ecosystems. Quoting from Dr. Leighton's earlier message:

> Earth and its environments must be recognized as dynamic, evolving, and subject not only to gradual changes, but also to disasters or catastrophic changes....A vast array of processes affect and shape our environment. Singly, or in combination, the processes produce environmental change....
>
> Not only should the processes inducing change be examined, but also the natural and human-generated processes that may counteract, alleviate, mitigate, or reduce the deleterious effects of changes on the health, safety, and well-being of humans in particular and the biological community in general. From this may flow sound, risk-based resource management strategies. Certainly, improved risk assessments are needed of the likelihood of negative impacts on public health, safety and well-being and on the biological community. Comparative risk assessments, continuously updated with new information, should help to focus debate on the real issues: whether risks and benefits are real or perceived; the real magnitudes of various issues and their benefits/costs; which problems are the most important; and which need to be addressed in the short-term and long-term. Budget constraints require the development of resource management strategies that appropriately balance the effort to reduce risks to public safety, and the health and well-being [of humans] along with risks to the biological community.

In a real sense, the concept of ecosystem management is being proposed as a means of focusing the increasingly limited resources of natural resource regulatory and research agencies on those aspects of the ecosystem where they will do the most good. If large parts of the total ecosystem are ignored, however, there is a strong possibility that errors will be made and, in the end, some of the limited resources will have been wasted.

Jon Goodwin and the Natural History Survey's Mike Jeffords (right), both strong supporters of science education, check out a joint project—the display "Biodiversity in Illinois."

The State Geological, Natural History, and Water Surveys and the Hazardous Waste Research and Information Center have the right combination of scientific expertise and information necessary to undertake the truly holistic and balanced approach to ecosystem management studies envisioned by Dr. Leighton. The recently completed first phase of the Critical Trends Assessment Project is a significant step already taken along this path. Devising ways for all the scientific divisions of the Department of Energy and Natural Resources (ENR) to undertake more cooperative research and service for the benefit of the people of Illinois is the exciting challenge Dr. Leighton has left to his successor.

Jonathan H. Goodwin

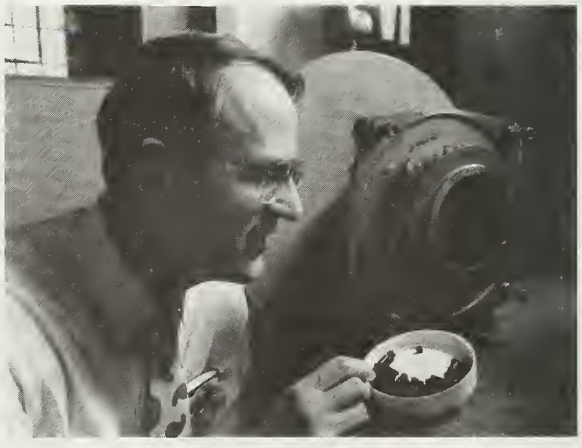
Jonathan H. Goodwin, Acting Chief

ENERGY AND MINERAL RESOURCES

The exploration, development, characterization, assessment, economics, and environmentally responsible use of Illinois' coal, oil and gas, industrial metallic minerals, and other mineral resources and products form the focus of the ISGS Energy and Mineral Resources Program. During FY 1993, oil prices have fluctuated between marginally economic and economic levels. Industrial minerals continued to appreciate in value. Coal consumption by Illinois utilities in 1993 dropped nearly 2 million tons from 1992 levels. Title IV of the Clean Air Act continued to adversely affect the use of Illinois coal. The ISGS program seeks not only to improve sulfur removal from coal, but also to find new uses for coal. Many significant developments in research and service activities were related to energy and mineral resources during this report period:

- The Petroleum Technology Transfer Council designated the ISGS as the midwest Regional Lead Organization (RLO). The organization transfers technology to the oil and gas independents across the United States. The ISGS will implement problem identification and focused technology workshops. As RLO, the ISGS will also serve as a resource center for oil producers who need information related to developing and producing oil.
- Six more mine maps and directories were released, bringing the total to nine in this series. The new maps are the Williamsville, Athens, Petersburg, Springfield West, Chatham, and Galatia 7.5-minute quadrangles (1:24,000 scale). All but the Galatia quadrangle are located in the vicinity of Springfield; the Galatia quadrangle lies north of Harrisburg in southeastern Illinois. This map series, initiated in FY 1992, has been popular among civil engineers and private citizens because of the detail provided by the maps. The accompanying directories contain information on the mines.
- The Illinois, Indiana, and Kentucky Geological Surveys (Illinois Basin Consortium) cooperated in the development of a project to characterize economic coal seams in the Illinois Basin in terms of chemical and physical properties that impact their future use by industry. The regional variation of properties will be depicted on a series of basinwide maps, which will be compiled into a comprehensive atlas on the characteristics of Illinois Basin coals. Funding for the multiyear project is being sought from a combination of sources, including the U.S. and state governments and the mining and utilizing industries.
- A study of spores in the Middle Pennsylvanian Lewisport Coal demonstrated that this coal is more extensive in southern Illinois, western Kentucky, and southern Indiana than it was previously thought to be. It had been given numerous local names in the past. The study, soon to be published, clarified correlations with the Dawson Springs, Mannington, Buffaloville, Kentucky No. 4, and other coals in the three states.
- Through the use of fossil spores, it was demonstrated that the "Boskydell" marine facies of the lower Pennsylvanian Tradewater Formation of southern Illinois occurs at four stratigraphic levels (*see* ISGS Circular 553). Previously, it had been considered one widespread marine layer. This significant discovery indicates that marine inundations of southern Illinois during earlier Pennsylvanian time were more frequent than previously thought to be.
- Fossil spores were also used to demonstrate for the first time that the thick sandstone-dominated sequence that characterizes the lower Pennsylvanian strata of the Caseyville Formation of southern Illinois (Morrowan in age) extends a considerable distance to the west into the Forest City Basin of Missouri. Prior to this study, conducted cooperatively with the Missouri Geological Survey, the sandstones in Missouri were thought to be younger.

- In Kansas, outcrops that straddle the Middle-Upper Pennsylvanian boundary, where major changes in flora occurred rapidly, were sampled at close intervals, and the samples were analyzed for fossil spore content (In Illinois, the boundary is represented by rocks barren of spores). The major change in spore floras occurs a few feet below the traditional boundary, basically confirming its placement. The study also revealed that black shales overlying coal beds in the western part of the Midcontinent may be of shallow rather than deep-water origin.
- The ISGS works with university and industrial organizations throughout the world to solve problems related to the use of Illinois coal. During this report period, the ISGS (1) worked with Steag AG, a German company, using activated char from Illinois coal to clean incinerator combustion gases; (2) collaborated with Carbotech, another German company, to develop carbon molecular sieves from Illinois coal; (3) provided coal samples for researchers from Illinois, five other states, and one foreign country; and (5) interacted with various other organizations.
- A proprietary direct method for the determination of organic sulfur in coal and char is being tested. When fully developed, it promises to be an improvement over the existing ASTM method and to be applicable to char, chemically treated coal, and other geologic materials. The selective oxidation approach is being tested for applicability to quantitative determination of organically associated chlorine and nitrogen in coal.
- Other projects related to the clean use of Illinois coal—and to a host of economic and environmental challenges—include (1) demonstrating that high-chlorine Illinois coals do not cause fireside boiler corrosion; (2) developing a process to produce high-surface-area hydrated lime to decrease SO_2 emissions from flue gas; (3) producing novel, low-cost activated coal char from Illinois coal; (4) producing ammonium sulfate fertilizer from flue gas desulfurization scrubber byproducts; (5) developing uses for fly ash, gasification slag, and other coal combustion residues; and (6) developing a process to produce cleaner-burning pelletized coal from fines produced by preparation plants.
- Studies of the Maquoketa Group shales have identified the clay mineral corrensite in some samples and yielded measures of the amount of "postburial" illite,



Minerals engineer Dave Rapp (above) works with coal residue, called fines, which will be formed into pellets. John Lytle, head of minerals engineering, examines pellets turned out by a small mill that simulates pellet production in industrial mills. Burning pellets made with fines from low-sulfur Illinois coal could help utilities comply with the stringent amendments to the Clean Air Act.

which could lead to accurate measures of the age and temperature of basin-wide heating.

- The Illinois Clean Coal Institute funded an ISGS proposal to test making bricks with fly ash and to determine the optimum procedures for using fly ash in low-cost ceramic materials.

ILLINOIS MINERAL INDUSTRY, 1992 AND 1993

The value of minerals produced in Illinois in 1993 dropped by about 20% from $2.6 billion to $2.1 billion, according to preliminary data. The decline reflects the drop in coal production from about 60 million tons in 1992 to about 42 million tons in 1993, primarily due to a strike by coal miners, but also to loss of contracts and closing of coal mines (table 1). The demand for Illinois' high sulfur coal fell after the 1990 amendments to the Clean Air Act imposed stricter regulations on older power plants but allowed greater flexibility in complying with them. Coal-producing counties were hit hard by unemployment rates twice as high as the state average. In some counties, revenues declined by as much as 10%. The 1994 production of coal is expected to recover to some extent as the labor strike has ended, although the recovery will probably fall short of the long-term average of 60 million tons. Significantly, the dollar value of Illinois coal production has consistently declined since 1981, despite nearly steady production, indicating the intensity of market competition from low cost, low-sulfur coals from other states and countries (e.g. Venezuela). Oil production declined slightly in 1993 but per-barrel value fell significantly, resulting in an 11% decline in total value. The only bright spot in the mineral industry of the state is the rise in production and value of construction aggregates, up about 2% and 5%, respectively. Industrial minerals continue to be the second most important mineral group in terms of dollar value (after coal) and the only group with a sustained growth since 1960 (fig. 1).

Table 1 Illinois mineral production data for 1992 compared with preliminary data for 1993.[a]

		1992		1993		% change from 1992 to 1993	
Minerals extracted	Unit	Quantity	Value ($ 1000)	Quantity	Value ($ 1000)	Quantity	Value
Fuels							
Coal	thousand tons	60,332	1,668,778	42,246	1,168,524[b]	-30.0	-30.0
Crude oil	thousand bbl	19,137	368,586	19,090[b]	334,075[b]	- 1.7	-10.7
Natural gas	million cu ft	346	743	250[b]	575[b]	-22.7	-22.6
Industrial and construction materials							
Stone[c]	thousand tons	72,700	322,800	73,500	338,100	+ 1.1	+ 4.7
Sand and gravel	thousand tons	40,105	180,461	41,273	189,389	+ 2.9	+ 4.9
Clay[d]	thousand tons	590	2,362	188	1,147	-68.1	-51.4
Metals, gemstones and other undisclosed[e]			63,845		42,080		-34.1
Total value of minerals extracted			2,607,575		2,073,895		-20.5

[a] Source: U.S. Bureau of Mines and Illinois Department of Mines and Minerals

[b] Estimated by Illinois State Geological Survey

[c] Dimension stone included with values that cannot be disclosed.

[d] Excludes fuller's earth; included with values that cannot be disclosed.

[e] Includes fluorspar, zinc, barite, peat, gemstones, and fuller's earth for 1992 and 1993, and copper, lead, silver and tripoli for 1992; no estimate for 1993.

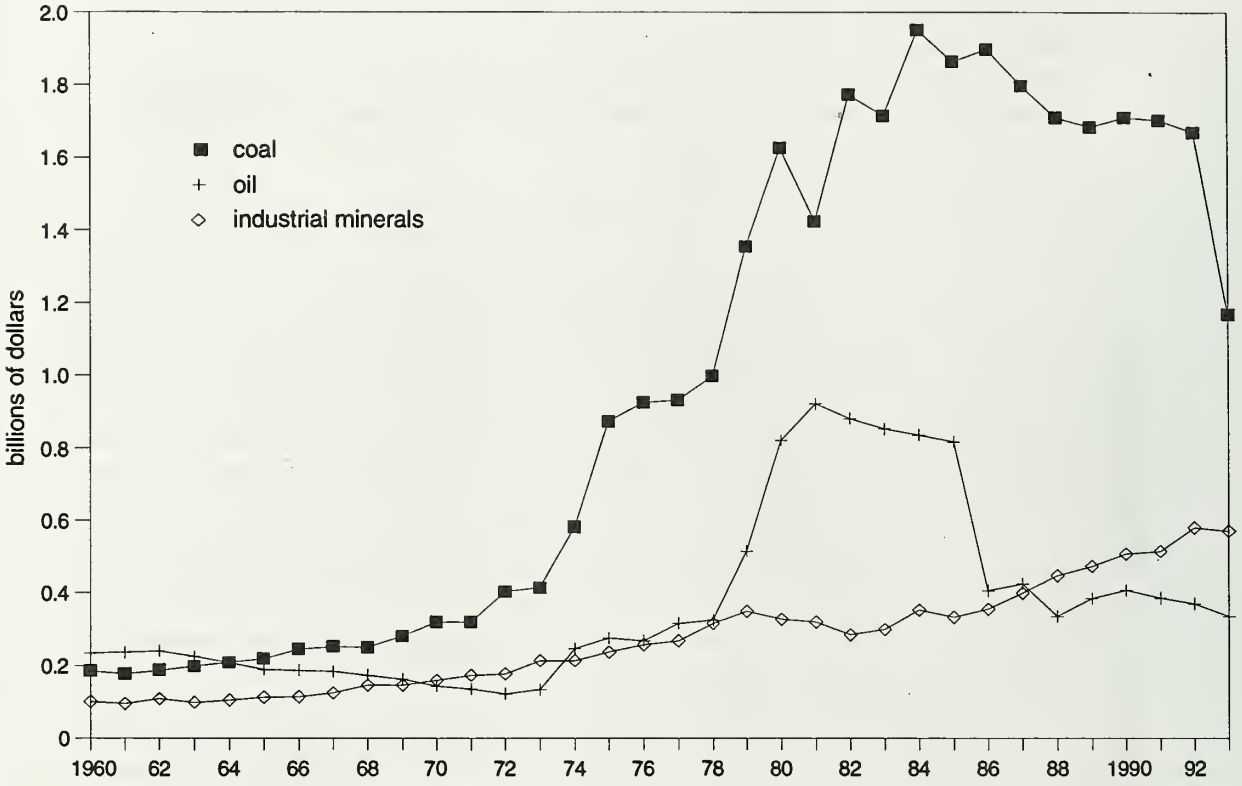


Figure 1 Value of Illinois minerals and fuels.

COAL

Illinois is a coal-rich state, but production has stagnated around 60 million tons per year for the past 15 to 20 years. Nationally, coal production has risen significantly. The relatively high sulfur content and the high price of much coal produced in Illinois has been the major reason for this lack of participation in the national trend. Railroad companies have recently lowered their transportation rates from the Powder River Basin of Wyoming. As a result, western coal has become very competitive (on the basis of equal heat values) throughout the Illinois Basin coal field. Generally low in sulfur content and competitive in price, western coals are projected to gain even more market share than in the past. The 1990 amendments to the Clean Air Act add additional pressure on the market for the high- and medium-sulfur coals typically shipped by mines in Illinois to older power plants, which were formerly exempt from the clean air restrictions applied to newer plants.

After the strike of the United Mine Workers of America in 1993, several mines did not reopen or opened only for a relatively short time. Peabody Coal Company closed its Eagle No. 2 underground mine in Gallatin County, Baldwin underground and River King No. 6 surface mines in Randolph County, and No. 10 underground mine in Christian County. The once largest coal producer of Illinois is left with only one operating mine in the state. Peabody cited difficulties in marketing the high-sulfur coal produced by these mines as the main reason for the closures. Sahara Coal Company closed its No. 6 surface and No. 21 underground mines in Saline County, primarily because of the exhaustion of reserves; Sahara has been a fixture in the coal mining industry of Illinois for many decades. Old Ben Coal Company, which closed its underground mine No. 25 in Franklin County, also blamed marketing difficulties. The company is considering additional mine closings. Monterey Coal has installed a longwall mining system at its No. 1 Mine in Macoupin County to mine a reserve of coal that has a relatively low-sulfur content—well below 2%, as compared with about 3.5% in

the currently mined reserves. The company expects to mine exclusively from the low-sulfur reserves by 1995. Similarly, Kerr-McGee has announced that it will stop producing high-sulfur coal from the Herrin (No. 6) Coal and will mine exclusively from its low-sulfur reserves in the Springfield (No. 5) Coal at the Galatia Mine in Saline County. The company indicated that the market for high-sulfur coal is drying up.

The projections for significantly reduced coal production in Illinois, presented 1 year ago in an ENR report to the Illinois Coal Development Board, may be materializing even faster than expected. A annual reduction by about 21 million tons to about 40 million tons by the year 2000 was projected, accompanied by the closing of mines and significant losses in jobs.

On the bright side, the 265-megawatt, Wabash River coal gasification repowering project of Public Service of Indiana near Terre Haute, Indiana, will start up next year. Using high-sulfur coal, the plant will produce electricity more efficiently than the previous generation of power plants, yet release little SO_2 into the air. Sulfur is removed during the gasification process before combustion; a valuable byproduct of the process is elemental sulfur. The power plant runs more efficiently on Illinois coal than on western coal because Illinois coal burns hotter and requires less water to form a pumpable coal–water slurry. Consequently, building the plant for Illinois was also cost-effective. Other clean coal technologies are currently in various stages of development and several economical and environmentally benign processes for use of medium- and high-sulfur coal should become commercially available early next century.

Coal Resources

Availability of Coal Resources in Illinois In this multiyear investigation, the geological and land use factors that restrict the minability of coal are being assessed to more accurately determine the resources available for future development. Similar studies conducted in the Appalachian coal fields in recent years found that less than one-half of the original coal resources may be available for mining because of environmental, legal, or technical restrictions. During this report period, the second and third of 18 to 26 planned studies of quadrangles throughout the Illinois coal field were completed. The geology and physiography of the Galatia and Mt. Carmel 7.5-minute quadrangles (each covering approximately 56 square miles) represent conditions in large areas of southwestern Illinois. Only 34% and 38%, respectively, of the original resources in these two study areas were found to be available for mining. Factors limiting the availability of coal were unstable roof conditions, unfavorable stripping ratios, thin coal, small or irregular mining blocks, and surface features such as towns, railroads, and cemeteries. Evaluations are now underway for two additional study areas, the Princeville Quadrangle northeast of Peoria and the Newton Quadrangle in central Illinois.

The results from evaluations of the selected study areas will be extrapolated to the entire coal field to stimulate new insights into the characteristics and availability of remaining coal resources. The U.S. Bureau of Mines will also use the data from these studies to calculate the cost of mining remaining resources. The information is essential to planners in government and industry for identifying the availability and cost of resources to meet the energy needs of the country.

Lands Unsuitable for Mining Program Under a cooperative program funded by the Federal Office of Surface Mining, ENR staff assist the Illinois Department of Mines and Minerals (DMM) with the application of geographic information system (GIS) technology to DMM's coal mine permit review program. All active mining permits and a wide variety of related geologic and natural resource parameters are compiled and maintained in GIS databases. The ISGS is responsible for databases on coal resources, mined areas, and other geologic parameters. Other ENR divisions are responsible for data on hydrology, biology, and archeology. These databases are used by the DMM to carry out

their regulatory duties in permitting, inspecting, and approving coal mining and reclamation activities in the state. ENR staffs use the databases to fulfill their mandate under the Illinois Surface Coal Mining Land Conservation and Reclamation Act to provide information to the public on natural resources in potential mining areas and to prepare land reports on sites petitioned to be declared unsuitable for mining.

During this report period, the ISGS developed a menu-driven interface for the GIS to help the DMM's staff retrieve information from a variety of natural resource and permit-related data, display maps, and produce plots or reports of permit information. High-resolution satellite imagery of the land surface may be displayed as a background for the other data. The interface, which has been well received by DMM staff, greatly facilitates access to and analysis of information.

The ISGS also developed procedures for exchanging digital data with coal mining companies. Digital data obtained from several of companies that have their own GIS were successfully loaded into ENR's database. This data exchange capability substantially reduces the cost of data entry and provides an opportunity for the ISGS to obtain additional data from mining companies.

Coal Characterization

Coals Shipped by Illinois Mines Among the numerous hazardous air pollutants (HAPs) identified in the 1990 Amendments to the Clean Air Act are 19 trace and minor elements commonly found in coal. Coal-fired power plants may be affected by regulations to be promulgated by the U.S. Environmental Protection Agency (USEPA), as required by the 1990 law.

Current coal-cleaning practices significantly reduce trace elements identified as potential air pollutants in as-shipped coal from 34 active mines in Illinois, according to recent research by geologist, Ilham Demir.

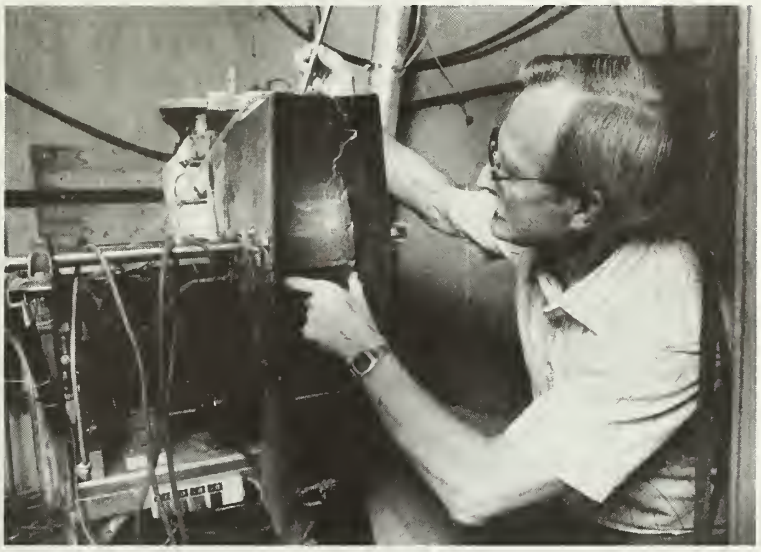
The substantial ISGS database on the trace- and minor-element content of coal in the ground is the product of collecting and analyzing representative channel samples for many years. Until recently, however, little was known about these elements in as-shipped coal. In 1992, we collected samples of shipped coal from 34 mines then active in Illinois and analyzed them for trace and minor elements; the project was supported by the Illinois Clean Coal Institute (ICCI). By comparing data on channel and shipped coal samples, we found that coal cleaning as currently practiced by the mining industry significantly reduces concentrations of most trace and minor elements.

We provided the Electric Power Institute (EPRI) with our data sets; EPRI works closely with the USEPA on the development of a comprehensive data set on which to base EPA's risk assessment and eventual possible regulations for HAP emissions from coal-fired power plants. The data show that risk assessment based solely on channel samples could significantly overestimate the risk inherent in the use of Illinois coals in power plants.

Present research focuses on determining how much additional beneficiation of already "washed" coals is possible by incorporating state-of-the-art froth flotation. Three size fractions (100, 200 and 400 mesh) were subjected to separation testing, which indicates the optimum cleaning possible via commercial column flotation. The cleaned products were analyzed for trace and minor elements. Preliminary results, compared

with the results from washed coals, show further significant reductions (up to 80% for fluorine, arsenic, and manganese) for most HAPs when "deep" cleaning is used.

Chlorine in Coal and Its Relationship with Boiler Corrosion Corrosion in boiler superheaters and reheaters has been correlated with total chlorine content of the British coals burned in them, according to literature published since the 1960s. By contrast, two recent studies, one jointly performed by the Electric Power Research Institute (EPRI) and the Illinois Clean Coal Institute (ICCI) and another published by the Chlorine Subcommittee to the Illinois Coal Association Technical Committee, indicated that many utilities in the midwestern United States have decades of experience with burning high-chlorine Illinois coals in many types of boilers, yet they have reported no chlorine-related fireside corrosion problems. Nevertheless, the use history for high-chlorine British coals causes U.S. manufacturers concern over use of high-chlorine Illinois coals in their boilers and reduces the marketability of these coals. If the extent of boiler corrosion is not directly related to the amount of chlorine in coal, it may relate to how chlorine occurs in the coal or other factors.



A continuous feed charring oven, demonstrated by senior research chemist Carl Kruse, takes volatile matter out of coal and produces coal char for various experiments.

The results of this study indicate that chlorine ions are more strongly bound in Illinois coals and suggest that the way in which chlorine ions are associated in Illinois coals is different from that in British coals. The results also indicate a difference in the ratios of acid-soluble alkali metals that may contribute to the corrosivity differences among these coals. These results may help to explain why high-chlorine Illinois coals have not caused fireside corrosion and relieve the concerns about using high-chlorine Illinois coals in boilers. Future studies will involve characterization of as-shipped high-chlorine Illinois coals and examine the chemistry that relates to corrosion of boilers.

Fuels and Chemicals from Coal

Activated Char (Carbon) The ISGS and ENR became aware in late 1993 that Steag AG of Essen, Germany, desired a domestic source of activated carbon to supply anticipated North American licensees of its process for removing dioxins, furans, mercury, SO_x and NO_x from incinerator flue gas. The ISGS, using expertise developed during recent ICCI contract research on molecular sieves and activated carbon catalysts, identified in April 1994 the laboratory conditions needed for making a moderate-activity, activated-carbon adsorbent from Colchester (Illinois No. 2) Coal donated by Freeman United from its Industry Mine. Allis Mineral Systems assisted as the laboratory steps were scaled up in May 1994 to make 500 pounds of the adsorbent. It was shipped by air to Essen, Germany, on June 14, 1994. Results of one commercial test and additional tests in a pilot plant unit will be made public.

Steag plans to license its technology to remove pollutants from incinerator flue gasses in the United States. More than 200,000 tons of activated carbon made from

German brown coal are used annually in Germany and the Netherlands for the granulated carbon technology. Adsorbers using some form of activated carbon technology are expected to be the best available technology when the USEPA sets flue gas emission limits next year. A domestic source of low-activity, activated carbon will be needed for American licensees of Steag's technology. Penetration of the market to retrofit 10% of U.S. incinerators could require as much as 80,000 tons of granular activated char annually. If this anticipated market were supplied with an adsorbent made from Illinois coal, the new market could require 160,000 tons of Illinois coal annually. Recognizing the importance of this potential market, the Illinois Coal Development Board, through ICCI, funded the cost of producing this 500-pound batch of adsorbent from Illinois coal.

Gus Ruch, senior research chemist, performs fluorine analysis of coal.

OIL AND GAS

Oil production dropped to 17,726,000 barrels in 1993 from 19,304,000 in 1992. The downward trend will continue as long as the price per barrel remains close to the economic limit for Illinois producers. The trend is not restricted to Illinois. Reliance on imported oil and petroleum products continues to increase throughout the nation.

Federal oil research makes assumptions about the equivalence of drive mechanisms and management strategies for all reservoirs of a given type. ISGS research has demonstrated that (1) effective production management of a class of reservoirs is highly variable, and (2) the amount of oil remaining in a reservoir as a percentage of the original oil in place is variable and can be quite large.

The ISGS has been selected to be the Midwest Regional Lead Organization, leading four states as part of a national petroleum technology transfer effort. In Illinois, unlike in other states with a comparably large remaining oil resource (1.2 billion barrels mobile and 3.9 billion barrels immobile in Illinois), independent producers make up the oil industry. The independent community needs information on improved reservoir management, and production and recovery technologies. The new technology transfer program will fill that need.

An extensive program of interdisciplinary, applied geoscience research aimed at maximizing production of Illinois hydrocarbons is conducted at the ISGS. The team approach bridges the traditional separation of geology and engineering and lends credibility and effectiveness to the program. The effort includes projects in resource assessment, improved oil recovery methods and concepts, hydrocarbon generation and migration, oil and gas databases and statistics, exploration concepts, reservoir engineering, and technology transfer and information services.

In 1993, 510 new test holes were drilled in Illinois: 290 new oil, 12 new gas, 20 reworked dry holes (now oil), and 2 reworked dry holes (now gas); 186 were dry holes.

New Exploration Concepts

Waulsortian Mounds as Hydrocarbon Reservoirs in Illinois Detailed subsurface mapping and outcrop studies, together with petrographic, sedimentologic, and biostra-

The prospect is located in Thebes Gap, a very narrow portion of the Mississippi River Valley and just south of Thebes in Alexander County, Illinois. The Kimmswick occurs at the surface here because of the combined effects of the dip of the bedrock at an angle of 3° to 5° out of the Illinois Basin, the presence of north-northeast-trending, right-lateral strike-slip faults in the bedrock, and the diversion and entrenchment of the Mississippi River into a saddle in the bedrock surface during the later part of the Wisconsinan glacial stage.

Clay Mineralogy and Diagenesis: Investigations for Enhanced Oil Recovery Many unique characteristics of oil reservoirs in Illinois were elucidated. Differences between clay minerals in the Aux Vases and Cypress reservoirs can affect recovery of oil and provide one way to classify the reservoirs; for example, the variety of the clay mineral chlorite found in the Aux Vases and Cypress reservoirs differed significantly. Several new methods were devised for measuring the mineralogical content of oil reservoirs and related sandstones and siltstones. These methods were shown to be five or ten times more accurate than more conventional approaches. Because clay minerals react rapidly with fluids used for well completion and enhanced recovery, the response of clay minerals to treatment in one field may differ significantly from that of another field. Well treatment strategies must be tailored to individual fields. These studies need to be extended to studies of other sandstone and carbonate reservoirs, and to investigations of the reactivity of different types of chlorite with various well treatment fluids.

MINERAL ECONOMICS

Oil Prices The economic implications of low oil prices were studied. For the United States, the oil price decline permitted a reduction in spending on oil imports as a percentage of gross domestic product (GDP), despite growing quantities of imported oil. Large benefits occurred in the transportation sector, although the benefits came at the cost of falling domestic oil production, loss of jobs in the oil industry, and increased import dependence. The effects on Illinois' oil-producing industry were more severe because nearly all oil wells in Illinois are "stripper" wells (less than 10 barrels produced per day per well), as compared with 75% of wells in that category nationwide. Most oil in Illinois is produced by small, independent operators with limited financial resources and borrowing power. Production losses since the mid-1980s amounted to $500 million annually, royalty losses were $80 million per year, and direct job losses totaled 4,100.

State and local governments lost tax revenues while their welfare expenditures increased. Local property values fell because of a general economic downturn. The State economy lost an estimated $1.5 to $2.0 billion in gross state product (GSP), although these losses were primarily borne by the relatively few oil-producing counties in southern Illinois. The State economy also gained about $2.8 billion in benefits because of low oil prices. The benefits were distributed over the entire population, more than 60% of which is concentrated in the Chicago area. The long-term damage to local economies and the structural damage to the State's economy cannot be measured. Given the high cost of exploration and production in the State's oil industry, research aimed at improving the success of exploration and the efficiency of extraction should receive the highest priority.

tigraphic data, are being used to develop a depositional model for the oil-bearing Mississippian Ullin Limestone ("Warsaw"). This work is leading to new insights into potential hydrocarbon plays in the Illinois Basin.

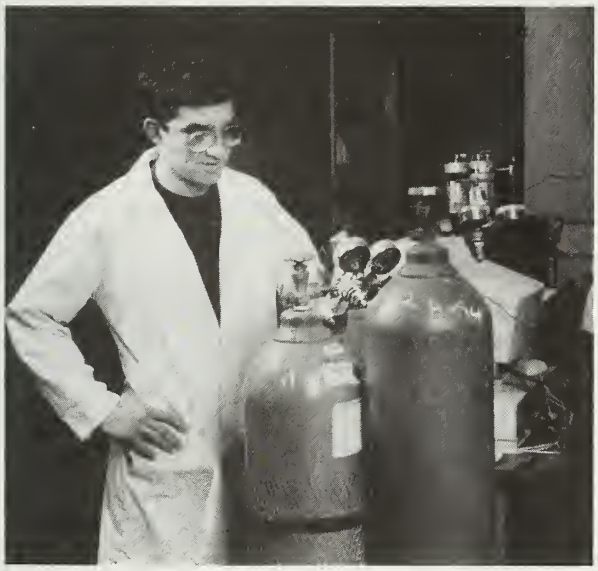
Until recently, the Ullin Limestone ("Warsaw") was a prolific hydrocarbon producer only in a limited number of oil pools. In two new fields, however, cumulative production from some wells exceeded 200,000 barrels of oil in less than 2 years. The reservoir potential for the Ullin appears to be greater than previously recognized.

The depositional model being developed for the Ullin is a significant tool for locating potential oil reservoirs in the Ullin. One of the main hypotheses of ongoing ISGS research has been the presence of Waulsortian-type carbonate mounds within the Ullin Limestone—a hypothesis supported by field observations. Waulsortian-type mound facies similar to those in the Ullin Limestone are prolific hydrocarbon reservoirs in several regions of North America.

Results of the study have been presented at scientific and industry-based meetings in the Illinois Basin region and at a national level. Publications are planned for the *Oil and Gas Journal* and other scientific journals. A public field trip to key quarries in the Ullin was conducted this spring (*see* ISGS Guidebook 25). The trip provided participants, including geologists in the oil industry, an opportunity to examine lithologic and sedimentologic relationships between various facies within the Ullin and adjacent units.

INDUSTRIAL AND METALLIC MINERALS

Limestone and Dolomite Resources Geologic information was exchanged between the ISGS and Union Pacific Minerals, Inc., during the evaluation of a high-calcium limestone prospect in the Thebes Gap in southern Illinois. The limestone is the Ordovician-age Kimmswick limestone. Chemical analyses of core samples from 14 test holes average 97.33% $CaCO_3$ and 0.81% $MgCO_3$ over an average thickness of 94 feet. Loss on ignition averages 42.93%. The prospect contains enough reserves to sustain an operation for more than 20 years. High-calcium limestone has many uses, for example, as a source of calcium, raw material for making lime, and an agent for capturing sulfur released by the combustion of coal.



Chemical engineer Tony Lizzio (above) researches the use of Illinois coal to produce carbon-based materials: carbon molecular sieves for separating gas molecules by size and activated char for removing SO_2 and NO_2 from combustion flue gas. Mahmoud At-Taras, research assistant, operates a column for cleaning fine-grained coal.

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GROUNDWATER AND ENVIRONMENTAL GEOLOGY

Groundwater resource protection and assessment were addressed by several projects this year. City, county, and other state agencies continue to support regional aquifer assessments, conducted cooperatively by the ISGS and ISWS (Illinois State Water Survey). Efforts by the ISGS to help protect local water supplies have led to innovative interpretations and use of geologic information about soils and near-surface sediments. Responding to inquiries about groundwater issues provides opportunities for the staffs of the ISGS and other ENR divisions to interact with the public, industry, and other government agencies. Through such inquiries, we are able to transfer vital information to decision-makers. The inquiries also indicate emerging needs for research and data collection.

ISGS environmental geology activities included preliminary environmental assessments and studies of wetlands for the Illinois Department of Transportation (IDOT), mapping and other investigations in areas prone to karst, monitoring and other studies of shoreline sediment movement in Lake Michigan, activities to help assess and reduce the risks of potential earthquakes, research on the effects of and responses to mine subsidence, and investigations of the causes of modern and ancient landslides. These projects were supported by sound research in the latest modeling technologies, laboratory analyses of the physical properties of soils and rock, and field instrumentation and monitoring.

- The ISGS supplied the USGS with a major technical report, *Landslide Inventory and Risk Assessment Along the Mississippi River from Chester to East St. Louis, Illinois*, which discusses the potential for landslides triggered by earthquakes in the New Madrid Seismic Zone.
- An exhibit highlighting ISGS and ISWS research on the Great Flood of 1993 was set up at the 1994 Illinois State Fair.
- Illinois' involvement in the Central U.S. Earthquake Consortium Organization of State Geologists led to a coordinated effort by Illinois and six neighboring states to prepare a multistate regional earthquake hazards map.
- In keeping with the ISGS mission to provide educational experiences, a 2-week field and laboratory exercise for exceptional high school students from Illinois and throughout the United States was conducted by ISGS staff. The event was part of the program sponsored by the Johns Hopkins University Center for Talented Youth. Students instrumented, monitored, and analyzed samples to evaluate the conditions of a wetland near Crystal Lake, Illinois. It was truly rewarding to see the excitement and satisfaction of these young women and men.

Collecting samples for a study of groundwater quality in Monroe County, geochemist Sam Panno is assisted by Joan Bade of the Monroe and Randolph Counties Health Department.

ENVIRONMENTAL STUDIES AND ASSESSMENTS

Screening of Proposed Sites for a Low-Level Radioactive Waste (LLRW) Disposal Facility in Illinois Public Acts 87-1267 and 88-458 amended the Illinois Low-Level Radioactive Waste Management Act and created a Task Group to be appointed by the Governor and charged with developing "...proposed criteria for selection of a site for a

facility for the disposal of low-level radioactive waste away from the point of generation." The ISGS and ISWS are required by the act to screen the state and "...identify at least ten locations, each of at least 640 acres, that appear likely to meet the criteria..." adopted by the Task Group. Screening process will start with the whole state and later focus on smaller areas. The ISGS and ISWS are also charged with evaluating "...any location of at least 640 acres that is volunteered by a landowner or unit of local government to determine whether the volunteered location appears likely to meet the criteria." The results of the statewide screening process will be published in reports to the chairperson of the Task Group.

The Illinois Department of Nuclear Safety (IDNS) contractor will evaluate the locations identified by the ISGS/ISWS investigators, select the three sites most promising for development of an LLRW disposal facility, and summarize evaluations of the three sites in a report to the Task Group.

The ISGS plan to meet its obligations under the Illinois LLRW Management Act has been reviewed with the Task Group. Highlighted were the different aspects of GIS data structure, map and well data quality, and map scale. An online GIS demonstration featured digital geologic data sets that might be useful in statewide screening (*see* ISGS Circular 546):

- Seismicity: (1) midcontinental seismic zones (New Madrid, Ozark, Wabash Valley), and (2) Charlestown, Missouri, earthquake scenario (epicenter, intensity contours, amplification of ground movement by surficial deposits)
- Geologic structures (faults, folds, domes)
- Aquifers (bedrock, and sand and gravel aquifers; karst areas)
- Thickness of glacial deposits and bedrock valleys
- Geomorphology (elevation, steep slopes, landslides, landforms)
- Mineral resources, mining, and waste disposal (coal resources, coal mines, pits and quarries, oil fields, landfills)
- Well data

A draft plan for GIS and computer mapping activities outlines the work awaiting ISGS staff: reviewing GIS data sets, digitizing additional maps, compiling well data and entering it into a database, and developing technical procedures in accordance with the project quality assurance (QA) plan. A draft version of the ISGS QA plan has also been developed, modeled after the plan prepared by Battelle for the IDNS in 1987. The ISGS plan will be modified to incorporate ISWS procedures. All tasks will be coordinated with ISWS staff. An overview of the screening process for a low-level radioactive waste facility was provided at the April meeting of county officials.

More than 350 miles of state highways have been covered by the ISGS team, including Damon Garner (left) and Dan Adomaitis, conducting environmental assessments of property for the Illinois Department of Transportation.

Environmental Assessments of Property for the Illinois Department of Transportation

In the fifth year of this major statewide endeavor for IDOT, 135 reports were completed, representing more than 350 miles of state highway projects. Projects ranged from a single parcel to 90 miles in length. A program to improve responsiveness to IDOT and enhance the quality of the program was initiated this year. Process teams now carry significant responsibility for program evaluation and improvement. Major accomplishments of these teams during the report year included the redesign of the new employee training program, evaluation of existing com-

puter systems, analysis of time required to complete each of the more than 40 steps for each project, and initiation of surveys of each of the nine IDOT districts to determine how to better meet their needs.

Environmental Assessments of Geology for Flood-Impacted Communities Work continued on various studies to aid Illinois communities in the process of relocating. For Valmeyer, for example, ISGS geologists reviewed the environmental assessment of the proposed new town site. The town's building and development ordinances have also been reviewed and comments provided to the Federal Emergency Management Agency (FEMA) to ensure proper development of the site. Basic geologic information on file at the ISGS was also presented to FEMA for the communities of Grafton, Hardin, Keithsburg, and Evansville in connection with development of environmental assessments for buyouts and relocations in those towns. The ISGS also reviewed draft environmental assessments for those communities, as well as for the buyout of Fults and unincorporated areas of Monroe County, and will review and comment on the ordinances for the partial community locations, as they are completed.

After describing the earth materials brought up from a borehole, hydrogeologist Dave Larson (above) bags samples for analysis and storage back at the ISGS. From the drill rig, geologist Phil Reed directs alignment of the cable for lowering the sond into the borehole, where the instrument records gamma radiation in surrounding earth materials.

GROUNDWATER RESOURCES AND PROTECTION

Geophysical Study of the Ticona Bedrock Valley near Streator, Illinois Municipal water supplies that use surface water commonly encounter a seasonal problem of high concentrations of nitrates. A potential solution is to blend groundwater with surface water and bring nitrate concentrations down to safe levels. The ISGS has been working with Northern Illinois Water Corporation, which supplies water to the city of Streator, to find a supplemental groundwater supply of 3 million gallons per day for blending with surface water and lowering nitrate levels during the spring. The buried Ticona bedrock valley, 6 miles north of Streator, runs east to west across central La Salle County. Possibly ancestral to the present Illinois River valley, the Ticona valley lies buried beneath 100 feet or more of glacial drift. Sand and gravel deposited in the ancient river bed is now being sought as a regional aquifer. Surface geophysical methods (seismic refraction and electrical resistivity) were used to produce detailed maps of the aquifer. With this information, the ISGS will assess the aquifer's potential, the feasibility of using it to supply Streator's needs for groundwater, and the potential impacts on local users.

Data from 10 line-miles of seismic refraction profiles were used to update bedrock topography maps with details on the geometry of the buried valley system. In addition, 119 resistivity profiles provided information on the variability of glacial materials above the bedrock. This large number of detailed profiles was made possible by upgrading our resistivity instrument to provide for computer-controlled data collection. Crew size was reduced by 50%. The resistivity work indicated that the bedrock valley is filled with

In Monroe County, the floodplain was deeply eroded when the Mississippi River breached a levee during the summer floods of 1993. Erosional scars may follow old plow furrows. The cuts are 1 to 2 feet deep.

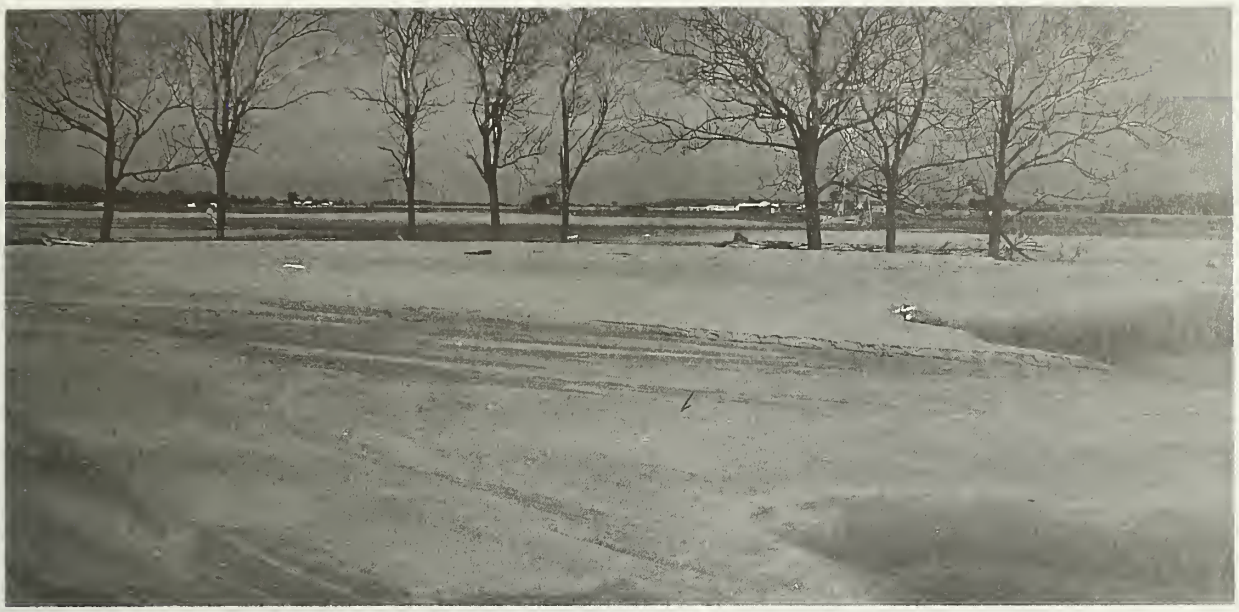
sand and gravel (with high potential as a groundwater resource) as well as silt and clay (with much less potential for groundwater resources). The quantity of silt and clay in the Ticona bedrock valley limits the probability of obtaining 3 million gallons per day from the aquifer; however, the study generated significant local interest and showed that the potential sustained yield of the aquifer is greater than current local usage.

Potential for Agricultural Chemical Contamination of Aquifers in Illinois: 1994 Update The USEPA's pesticide and groundwater strategy required each state to develop a plan for management of pesticides in groundwater. Responding to this mandate, the Pesticide Subcommittee of the Interagency Coordinating Committee on Groundwater developed the Illinois State Management Plan for Pesticides in Groundwater. The ISGS was asked by the Illinois Department of Agriculture to reevaluate the 1991 study, "Potential for Agricultural Chemical Contamination of Aquifers in Illinois," to determine whether interpretation of the data could be improved for better integration into the generic plan. Results from our pilot study to evaluate agrichemicals in rural private water wells and a new statewide map and database of soil associations throughout Illinois provided the bases for significant insights as well as the new data needed to improve on the 1991 mapping.

A new series of maps illustrates the sensitivity of soils and aquifers to contamination from nonpoint-source leaching of pesticides and nitrate. Two maps, *Soil–Pesticide Leaching Index for Illinois* and *Soil–Nitrate Leaching Index for Illinois*, were produced by combining several soil properties to provide an independent measure of the relative leaching potential of pesticides or nitrates in Illinois soils. These maps were combined with a map of depth to the uppermost aquifer in Illinois to produce two other maps, *Aquifer Sensitivity to Contamination from Pesticide Leaching in Illinois* and *Aquifer Sensitivity to Contamination from Nitrate Leaching in Illinois*. These maps indicate the likelihood for nonpoint-source contamination of aquifer systems within 50 feet of land surface and form the scientific basis for the generic plan. The state and county maps will be published together with a report.

WASTE MANAGEMENT

Field Verification of Landfills and Special Waste Sites: Cooperative Agreement with the Hazardous Waste Research and Information Center A critical element in the IDOT property assessment studies is the accurate location of landfills and special waste



Near the Columbia levee breach in Monroe County, 3 to 5 feet of sand was deposited like snowdrifts. Geologist-author Mike Chrzastowski, artist Pam Carrillo, and editor Ellen Wolf work on the layout of the Special Report 2, *The Great Flood of 1993.*

sites that might affect the acquisition of rights-of-way by IDOT. Continuing a cooperative program with HWRIC, the ISGS is providing field-verified locations of such sites to HWRIC to incorporate into their GIS databases. Currently, these sites may be located only to the nearest township or center of a municipality. Site locations are field-checked by ISGS geologists and plotted on a map; the information is then returned to HWRIC for use in refining the locations recorded in their databases.

RIVER INVESTIGATIONS

The Great Flood of 1993 The ISGS published Special Report 2 in March 1994. Focusing on the geological aspects of the 1993 flooding in Illinois, this 45-page, well-illustrated report explains in nontechnical language how the landscape and geologic materials near land surface affected the flooding, and how the landscape was changed through processes of erosion and deposition during the flooding. Special Report 2 summarizes observations made by ISGS geologists who studied the flood-impacted areas as water levels began to decline in the late summer and autumn of 1993. An overview of the findings was presented at the Governor's Workshop on the Great Flood of 1993, held in Springfield on March 1, 1994.

ISGS field studies documented that the erosional and depositional impacts were most pronounced near levee breaches, where deep scour holes were eroded to tens of feet below the original floodplain surface. Adjacent to the scour holes, erosion removed up to several feet of the soil profile in some localities. Beyond the erosional zones of levee breaches, sand deposition formed extensive sand sheets across the floodplain. The result was a desert-like setting that spread across tens to hundreds of acres. Mapping such a sand deposit across near the breach of the Columbia levee south of St. Louis determined that more than 6 inches of sand covered approximately 760 acres; the maximum recorded sand thickness was 8 feet.

GEOLOGIC MAPPING AND FRAMEWORK STUDIES

Geologic maps, cross sections, and three-dimensional geologic models are useful for portraying the distribution, character, and age of Quaternary glacial deposits and Paleozoic sedimentary rocks in Illinois. Geologic field mapping, a fundamental means of increasing knowledge about the earth, can generate vast numbers of practical observations and research opportunities. Map products of various kinds generally provide the basis for mineral resource, groundwater, environmental, earth hazard, and engineering studies that directly affect the health, safety, and well-being of the people of Illinois.

Framework investigations focus on developing the knowledge of stratigraphic units and structural features required for definition of relevant map units and for meeting a host of both practical and fundamental research needs. Techniques used in basin-wide framework studies include geophysics, stratigraphy, structural geology and paleontology, and analysis of modern geologic processes. Geophysical studies provide information about the deep crustal structures that now influence earthquake activity, formerly controlled the origin and development of the Illinois Basin and surrounding domes and arches, and affected the distribution of mineral resources. Paleontological studies support stratigraphic correlations and relative age determinations, offer significant guidance for understanding depositional environments, and provide critical evidence for interpreting paleoclimates. Studies of modern geologic processes aid in the understanding of past environments of deposition, weathering, and erosion, and help assess consequences of human activities.

Computer-assisted techniques developed at the ISGS are used to generate many types of maps. Don McKay, head of geologic mapping, and geologist Lisa Smith check over the delineation of subsurface materials on work maps related to landfill siting.

Computers and geographic information system (GIS) technology are valuable tools employed in mapping and framework investigations. They provide a means of visualizing complex geologic relationships, spatially analyzing maps, manipulating the large geoscience data sets required by basic studies, and outputting maps and cross sections for distribution.

Several significant geologic mapping and framework activities distinguished this report year:

- The first unequivocal evidence for faulting within the last 65 million years (post-Cretaceous) was discovered in Quaternary alluvial deposits in southernmost Illinois during geologic mapping of the Mermet and Reevesville 7.5-minute quadrangles.
- The *Geologic Map of the Makanda Quadrangle in Jackson, Union, and Williamson Counties, Illinois* (ISGS IGQ 11), the result of a cooperative ISGS and USGS program, was published.
- Two geologic mapping projects. slated to begin in FY 1995, were approved for funding by the USGS: the Mt. Pleasant and Anna 7.5-minute quadrangles

in Union County and the Elburn and Geneva 7.5-minute quadrangles in Kane County.

- Geologic maps to facilitate landfill siting decisions in Will and Lake Counties have been published; mapping of McLean County is in progress.
- Geologists, hydrogeologists, geologic mappers, engineering geologists, and Quaternary stratigraphers investigated the geology of the proposed site for relocating of the town of Valmeyer, Illinois, which was destroyed by flooding in August 1993. Data gathered in the field studies were compiled into maps and cross sections to illustrate the geologic setting and potential hazards of the proposed site.
- The ISGS hosted the International Paleopedology Symposium at Allerton House in Monticello, Illinois, August 8–12, 1993. The symposium, cosponsored by the International Quaternary Association and the International Soil Science Society, brought together paleopedologists from 15 countries to discuss current research in the study of ancient soils.
- The National Science Foundation renewed funding for the study, Subglacial Till Genesis and Ice Sheet Dynamics, a project that will expand understanding of the geologic processes during deposition of the glacial materials that cover a large portion of Illinois.
- Cross sections of the geology of Quaternary deposits between the Mississippi and Illinois Rivers in western Illinois confirmed that pre-Illinoian glacial sediments from a western source extend to near the Illinois River and constitute the bulk of the glacial deposits in that area.
- The manuscript, "Illinois' Ice-Age Legacy," was completed for the ISGS Educational Series.
- A major revision of the stratigraphic framework of the last glacial episode was completed and will be published as an ISGS Bulletin. The revised classification provides an updated, practical framework for both applied and fundamental geologic investigations.
- Papers on the paleohydrological changes associated with climate changes during the last 150,000 years were presented at scientific meetings of the North-Central Section of the Geological Society of America and the American Quaternary Association.
- Subsurface stratigraphic analysis of coal-bearing rocks of the basal Pennsylvanian System in the southern Illinois Basin shows that low-sulfur coal can be traced extensively over Illinois, Indiana, and Kentucky.
- Significant progress was made in curating the Collinson conodont collection, one of the most important paleontological reference collections for the Midcontinent of the United States.
- The National Science Foundation renewed support for a study of Ordovician K-bentonites, a project that is fostering insights into the distribution of these ancient volcanic ash beds in the Illinois Basin and adjacent parts of eastern North America as well as in South America

Entering data on water wells, oil wells, structure tests, coal tests, and other exploration drilling into the ISGS database is a daily responsibility of Jo Junkins (seated), who demonstrates the basics to administrative aide Pam Cookus.

and northern Europe. The scientific community is interested in the possible effects of these large ash falls on global extinctions.

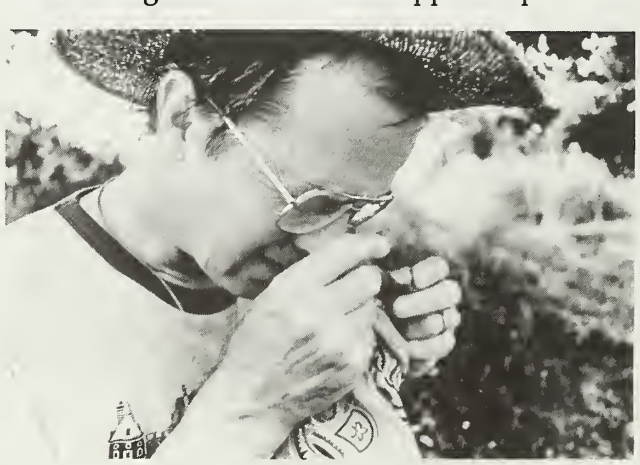
- Customized maps showing the extent of the 1993 flooding along the Mississippi and Illinois Rivers were prepared using the GIS and delivered to many local, state, and federal agencies.
- A digital, shaded relief map of Illinois at the 1:500,000 scale was produced from USGS digital data using GIS technology. The gray-shaded map shows landforms and topographic relief.
- ISGS staff presented testimony, based on long experience with GIS technology, to the Illinois General Assembly's Task Force of Geographic Information Management Technology.
- GIS staff at the ISGS again participated in the Hire the Future Program, which encourages youth aged 16 to 21 years to aspire to professional or growth-oriented careers. Students were trained to use the GIS to prepare maps that will become part of the ISGS digital database.
- At the invitation of the Illinois Emergency Management Agency, GIS staff participated in a multicounty earthquake exercise in earthquake-prone southern Illinois and provided advice on the use of GIS technology with maps for data collection, map preparation, and disaster response.
- A sizable database of geologic maps in GIS format was provided to the Illinois Environmental Protection Agency (IEPA) for use on their newly installed GIS.

GEOLOGIC MAPPING

McHenry County Geologic mapping for groundwater protection planning in McHenry County is in the second year of a 3-year project. Its purpose is to increase the data on the geologic and hydrologic framework of the county at a level of detail useful for planners requiring information on aquifers and their potential for groundwater contamination.

Data on each of the fifteen 7.5-minute quadrangles in the county has been evaluated for availability and quality. Water well and test boring locations have been plotted, stratigraphic relationships have been determined, and more than 40 cross sections have been constructed. Twelve test borings were drilled and sampled to a maximum depth of 250 feet. Piezometers were constructed in the deeper holes. Samples have been run for determination of grain size and clay-mineral composition of tills.

Geologic maps are being prepared using a stack-unit approach to classify the sequence of geologic units within 100 feet of the ground surface. This approach provides not only detailed information on the distribution and thickness of near-surface geologic units, but also lends itself to interpretations for a variety of uses, specifically the potential for occurrence of groundwater resources and the susceptibility of those resources to contamination.



Curiosity is an asset to geologist Jack Masters, coauthor of a recent study that resulted in a new hydrothermal theory of the origin of microcrystalline silica (tripoli) in southern Illinois.

BASIN ANALYSIS

Origin of Tripoli in Southern Illinois Tripoli or microcrystalline silica, mined in Alexander and Union Counties of southern Illinois, is used in pol-

ishes, abrasives, fillers, and other products. It occurs as bedded deposits chiefly in the Devonian Clear Creek Formation. Elsewhere in southern Illinois, the Clear Creek is a cherty limestone. During 1989 to 1990, a senior geologist on exchange from the Montana Bureau of Mines and Geology joined an ISGS staff member to conduct a study on the geology and origin of tripoli in southern Illinois (*see* ISGS Circular 555). They concluded that the deposits are hydrothermal in origin: groundwater heated by deep-seated igneous intrusions circulated through fractures in the rock, removed carbonate minerals, and concentrated silica. The new theory, which differs from the previous interpretation that silica was produced by weathering of siliceous limestone, implies that tripoli and possibly other valuable mineral deposits may be found at depth. According to the weathering theory, tripoli would be near the surface only.

"Drilling is essential to mapping the geology we can't see—materials beneath the earth's surface," explains geologist Myrna Killey. "We refer to this as a sequence or succession of stratigraphic units, which simply means layers of rock."

The entire tripoli district was geologically mapped from 1990 to 1993. Findings from the mapping supported the hydrothermal theory and further showed that rocks in the tripoli district are more closely fractured and faulted than rocks in the surrounding area. The fractures probably were pathways for hydrothermal fluids and enhanced the replacement of limestone by silica. The information will be reported as geologic maps (ISGS Illinois Geologic Quadrangle series) of the Wolf Lake, Cobden, Jonesboro, and Mill Creek Quadrangles, ISGS Bulletins, and papers in scientific journals.

QUATERNARY FRAMEWORK

Stratigraphic Reclassification of Glacial Deposits in Northeastern Illinois Deposits of the last glacial episode blanket most of Illinois and Lake Michigan, locally reaching thicknesses of more than 500 feet. These deposits, studied for more than 125 years, were classified as the Wisconsinan Stage by Willman and Frye in ISGS Bulletin 94, *Pleistocene Stratigraphy of Illinois* (1970). As the result of information gained in the past 25 years, the classification system has been revised to make it more practical for basic and applied scientific investigations. The revision is the subject of a forthcoming ISGS bulletin, *The Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area.*

Increased demand for detailed geologic information in mapping and applied studies led to restructuring the stratigraphic framework for classifying deposits of the last glaciation. At a particular location, these deposits record the migrations in time and space of proglacial and glacial environments. Proglacial deposits consist mainly of loess, eolian sand, lake sediment, and outwash, whereas glacial deposits consist mainly of till and ice-marginal deposits. In the former classification, buried deposits, except for loess units, were treated as informal facies of till units, a practice that tended to deemphasize their importance for regional correlative purposes and made map unit definition awkward. The distribution and correlation of these subsurface units is critical, however,

for most practical applications as well as for understanding glacial history. The deposits of the last glaciation are classified into two interfingering groups in the revised framework. The till and ice-marginal deposits are in the Wedron Group, and the proglacial sediments in the Mason Group. Four formations and eight members are described in the Wedron Group, and three formations, two members, and three tongues are described in the Mason Group.

SPATIAL ANALYSIS AND MAP PRODUCTION

GIS Mapping and Database Compilation for Identification of Potential Low-Level Radioactive Waste Sites The Illinois Low-Level Radioactive Waste (LLRW) Management Act names the ISGS and the Illinois State Water Survey as the agencies to identify candidate areas for an LLRW disposal facility. Criteria for selection of the areas are to be developed by the LLRW Task Group appointed by the Governor. A statewide screening, employing 1:500,000-scale (1 inch = about 8 miles) geologic, hydrologic, and geographic maps, will be used to eliminate parts of the state and identify other possible candidate areas that require further study. The ISGS and ISWS will select at least ten regions that are likely to meet the criteria and map these regions in detail at 1:100,000 scale (1 inch = about 1.6 miles). The candidate regions and any volunteered sites will be evaluated by the Illinois Department of Nuclear Safety (IDNS).

Members of the ISGS team have participated in Task Group meetings, established a quality assurance plan, developed technical procedures for GIS activities, identified geologic data sets that might be utilized for statewide screening, automated new map information and well data, documented GIS datasets, and upgraded computer hardware that will support project activities. An online GIS demonstration highlighted selected digital maps that could be used for statewide screening, including maps of seismicity, geologic structures, aquifers, thickness of glacial deposits, bedrock valleys, land surface elevation, steep slopes, landslides, mineral resources, mines, landfills, and wells. Newly digitized maps and existing GIS data sets are being checked for accuracy. This quality review will identify and correct errors and provide documentation on each map. Project staff have assessed the availability and quality of digital well data and are working to supplement the data with records that have not previously been automated. These efforts are progressing steadily to lay a firm foundation for GIS input into decisions concerning sites.

GEOCHEMICAL INVESTIGATIONS AND SERVICE

Geochemists lead important investigations into every active area of research at the ISGS and also provide a wide range of analytical services. The geochemical capabilities include analyses of rock, mineral, water, and gas samples for major, minor, and trace element content; pesticide analyses; geochemical fingerprinting of oil, gas, water, and organic contaminants; radiocarbon date determinations; and stable isotope analyses. The breadth and depth of analytical capabilities make the ISGS unique among state geological surveys.

Several applications of geochemistry to environmental studies distinguished this report year.

- The occurrence, environmental fate, and mobility of pesticides in soils and groundwater was investigated at agrichemical distribution facilities: (1) Fill material samples were analyzed for atrazine and other pesticides to determine the extent of contamination at these sites. (2) Backhoe excavations at one facility revealed evidence of preferential flow paths for spilled atrazine. (3) Column leaching and batch adsorption studies of atrazine on fill materials were completed to help evaluate potential mobility of spilled pesticides. (4) A feasibility study on the degradation of atrazine in soil by white rot fungus was conducted. (5) Laboratory work on the development of pesticide-spiked soil samples was completed.
- Pollution related to Illinois lakes, rivers, and streams was investigated: (1) Three cores from the Grand Calumet River system were analyzed for sedimentation rates, organic composition, and metal concentrations as part of an ongoing ISGS project on the geochemistry of sediments in lakes and streams. (2) A joint ISGS/ISWS project on contamination of sediments in central Illinois backwater lakes continued with collection and chemical analysis of samples from six cores. (3) Results from a joint research project with the Illinois Natural History Survey (INHS) on plants and water quality at a Vermilion County seep area were presented as a poster paper. (4) The

Geochemist Rich Cahill and INHS botanist Marilyn Morris check samples from one of 14 seep communities studied in Vermilion County. Seeps are places where groundwater percolates to the surface and forms wetlands.

chemistry of sediments in Copper Slough and the Kaskaskia River headwaters, a joint project with researchers at the University of Illinois, got underway. (5) To assist in assessing the effects of the Great Flood of 1993, geochemists analyzed samples of ground and surface water collected in the Rock Island area after flooding.

- Other investigations related to groundwater resources and protection: (1) Field and laboratory work were completed for a study on the genesis of shallow saline groundwater in central-southern Illinois.

Several applications of geochemistry to energy and mineral resource studies distinguished this year:

- A series of samples was analyzed to help evaluate the environmental effects of the codisposal of coal fluidized-bed combustion residues and coal slurry solids. The final report was submitted to the Illinois Clean Coal Institute.
- Cores were drilled at five locations in a reclaimed coal slurry impoundment, and groundwater samples were collected at one location 1 month later.
- Concentrations of major, minor, and trace elements in coal samples from a coal washability study were determined.
- To help predict occurrences of oil and gas, research on the cross-basin correlation of source rocks and oils continued. A paper is being prepared on the correlation of different Ordovician oils in the Illinois Basin.
- A paper describing oil from the deepest exploratory oil well in Illinois is being prepared.
- Collaborative research with the USGS to redefine thermal maturity indicators and reserve estimates for oil in the Illinois Basin is underway.

Other research and service highlights included the following:

- The geochemistry of more than 30 samples of granitic basement rocks from the ISGS collections was examined by Professor Yang Ruiying, a visiting research scientist from the Institute of High Energy Physics of the Academia Sinica in Beijing, Peoples Republic of China. There is a high probability that several separate igneous bodies constitute the crystalline basement rocks in Illinois and that the surface of the basement rocks may be weathered.
- To provide services to other scientists and to conduct their own investigations, the staff of the isotope geochemistry laboratory performed 1,604 $^{13}C/^{12}C$ and $^{18}O/^{16}O$ determinations, 453 $^{15}N/^{14}N$ determinations, 125 $^{34}S/^{32}S$ determinations, 209 $^{2}H/^{1}H$ determinations and 243 radiocarbon age determinations on geological and archaeological samples for scientists throughout the state.
- A preproposal for research into the occurrence of indoor radon in Illinois was approved by the Illinois Department of Nuclear Safety and a proposal is being prepared.
- The literature on naturally occurring radioactive materials in oil field brines is being reviewed.
- The analysis of Illinois soils for inorganic composition is continuing, helping to provide background information on what is natural and what is contamination.
- A paper on the oxidation of organic carbon by sulfate-reducing bacteria in hypersaline mats was accepted for publication.
- As part of a study to help understand the various occurrences of methane, a paper on the kinetic isotope effects associated with acetoclastic methanogenesis was published.
- The use of stable isotope analysis of hydroxyl in soil clay minerals as an indicator of paleoclimate conditions is being investigated. A differential thermal extraction system to selectively extract hydroxyl from different clay minerals in soils has been completed and provides reproducible results.

ENVIRONMENTAL GEOCHEMISTRY

Pesticides in Soil and Groundwater

Fate and Transport of Atrazine in Gravel Fill Materials at Agrichemical Facilities Gravel parking lots and road bases at retail agrichemical facilities may contain relatively large concentrations of pesticides, which may leach into the groundwater system. This investigation will provide information needed by the Illinois Department of Agriculture (IDOA) and the IEPA for development of scientifically valid fill-cleanup objectives, and help to identify cost-effective fill-remediation techniques. Preliminary data are pointing in some unexpected directions. The <2-mm fraction of the fill generally behaves more like a slightly alkaline, low-organic-carbon soil (in terms of atrazine adsorption) than was expected for the parking lot gravels. These soil-like properties would tend to reduce atrazine leaching. There is indirect evidence that the most contaminated fill samples contain solid-phase atrazine. Dissolution studies suggest that this solid component dissolves slowly, and the dissolved atrazine may then be adsorbed by the fill. Both processes would contribute to a lack of rapid leaching.

The column, crafted by Oscar Richter in the ISGS machine shop, is used by geochemist Bill Roy (above) in studies of pesticide movement through gravels. After packing material into the column, he adds water and collects the leachate for analysis.

Evaluation of Pesticide Releases from Retail Agrichemical Facilities During the 1993 Flooding in Illinois About 15 retail agrichemical facilities in Illinois were flooded along the Mississippi, Illinois, and Kaskaskia Rivers in 1993. Although evacuations of inventories prevented catastrophic releases of pesticides from the flooded facilities, there were concerns that some pesticides may have escaped into the environment. A total of 40 samples from fill and flood-related sediments were collected at six facilities. No significant accumulation of flood sediments was present at any facility investigated, and only one facility showed field evidence of pesticide-containing fill having been washed off-site.

Atrazine and metolachlor were detected in every sample collected on-site, and cyanazine was present in 89% of the samples. Pesticides were also detected in off-site samples at five of the facilities. Of the 21 samples collected off-site, atrazine was detected in 86% of the samples and metolachlor was identified in 81% of the samples. When compared with the on-site concentrations, concentrations of off-site pesticides occurred at either comparable levels, or were up to 3 orders of magnitude less. There were no background data on the occurrence and distribution of pesticides at the sites before flooding, which made data interpretation difficult and often inconclusive. Although pesticides were detected off-site, this study did not find strong evidence that the flooding of retail agrichemical facilities had resulted in significant off-site movement of pesticides or pesticide-containing fill.

Geochemistry of Wetlands

Organic and Inorganic Geochemical Studies of Water and Sediments in Wetlands The ISGS and INHS are cooperating in this project, which is being conducted with

partial support from IDOT. At several locations, including natural areas and recently constructed mitigation sites, water samples are being collected for both inorganic and organic chemical analyses. A major goal of this project is to develop geochemical indicators for establishing water quality guidelines to be used in monitoring constructed wetlands.

At a wetland study area in Schaumburg, measurements of the inorganic composition of water samples collected over a 2-year period indicate that concentrations of sodium and chloride in the water vary seasonally, probably depending on whether there is salt-laden runoff from an adjacent parking lot.

The organic chemistry portion of the project has focused on elucidating both naturally occurring compounds and nonnatural contaminants in wetland sites. Analytical methods include solvent extraction and column chromatography for the separation of classes of organic compounds with data collected utilizing GC/MS and py-GC/MS. Lack of data and standards for the occurrence of most organic compounds in sediments make it difficult to take action on contaminated sites. The main thrust of the project is to provide data for reliable judgments about concentrations of organic compounds in wetland sediments and water, and to determine the potential danger to plants, animals, and people.

ISOTOPIC ANALYSIS

Use of Environmental Isotopes to Identify Groundwater Contamination at CID Landfill Landfill products such as methane and leachate are formed by repetitive fermentation processes and acquire distinctive isotopic signatures that are traceable. The purpose of this project is to apply environmental isotopes as tracers to investigate landfill-related contamination and to identify, in particular, the source of oil found in monitoring wells at the CID site, a municipal landfill located in southern Cook County.

The results obtained from this study demonstrate the power of isotopic analyses ($^{2}H/^{1}H$, $^{13}C/^{12}C$, ^{14}C and ^{3}H) in identifying the type and migrational pathway of landfill contamination. For example, the oil found in groundwater monitoring wells has been positively determined to have migrated from the landfill; groundwater and oil from two monitoring wells exhibit isotopic characteristics indistinguishable from those of leachates and oil samples from within the landfill. This research, sponsored by Rust Environmental and Infrastructure, was completed during the report period.

Ivan Krapac, geochemist, collects water samples from a spring in southwestern Illinois. The ISGS is looking into pesticide migration in karst environments.

Applications of Tritium Analysis to the Study of Landfill Contamination and Groundwater Hydrology Recent studies at municipal landfills have demonstrated that the tritium (^{3}H) concentrations in landfill methane and leachate (200 to 8000 tritium

units, or TU) are 1 to 3 orders of magnitude higher than those (0 to 15 TU) observed in surrounding groundwater. These elevated tritium concentrations are believed to be the result of disposal of items with luminous paints (watches, glow-in-the-dark signs). The observed tritium concentrations in the landfill gases and liquids, although not so radioactive as to be considered hazardous, have tremendous potential as indicators in monitoring landfill contamination problems. Results of investigations on three municipal landfills located in northern Illinois have shown that tritium determination can be used not only to detect landfill contamination but also to differentiate the source(s) of contamination (landfill gas versus leachate).

Groundwater that has fallen as rain in approximately the past 40 years contains detectable concentrations of tritium, whereas older water does not. As a result, tritium analysis is also very useful in groundwater research, particularly in the determination of groundwater recharge rates, flow directions, and aquifer communication. These are all important criteria in siting low-level nuclear waste repositories or landfills.

These important applications of tritium analysis have necessitated the construction of an in-house facility for the determination of tritium. (Until now, all samples have been sent to a commercial laboratory in Florida.) Most of the major components for an electrolytic tritium enrichment system have been ordered. It is estimated that 3 to 6 months will be required to assemble the hardware and another 3 to 6 months to test and calibrate the system.

BIOGEOCHEMICAL INVESTIGATIONS

Community Structure of a Microbial Mat: The Phylogenetic Dimension Microbial mats provide insights into (1) the atmospheric and oceanic chemistry of Earth from the Archean (about 3,500 million years ago) to the present, and (2) the biogeochemical cycling and preservation of organic carbon. In these communities, bacterial sulfate reduction is the major pathway in the mineralization of organic carbon and accounts for more than half of the organic carbon oxidized. Traditional studies of microbial communities have been incomplete without a way to identify and quantify all contributing populations. In this study, the abundance and distribution of sulfate-reducing bacterial populations in a microbial mat community were directly determined using RNA probes to identify major phylogenetic groups of bacteria. Most major groups were found in this single mat community, primarily distributed in discrete sequences from the oxic zone to the bottom of the mat. The reflection of the phylogenetic structure in the community structure suggests that species in the major phylogenetic groups perform specific, interrelated metabolic functions in the community. Comparison of population profiles with previously observed rates of sulfate reduction suggests additional novel populations of sulfate-reducing bacteria exist both within the photooxic zone and deeper in the mat.

TECHNICAL AND ADMINISTRATIVE SERVICES

A variety of technical and administrative services are necessary to support the operations of ISGS research and service and to deliver the results to our users. Internal functions include

- record keeping, accounting, budget planning, and other fiscal services required for ISGS operations;
- editing, illustrating, and assembling camera-ready copy of scientific and educational publications;
- maintaining and operating the buildings, scientific and technical equipment, and automotive equipment;
- designing and constructing customized laboratory and field equipment and instruments.

Special public services include

- distributing publications, maps, documents, and other information to the public, government, and media; helping the public interpret and understand the technical information;
- explaining the nature and purpose of our research and service activities;
- collecting and maintaining geologic records and samples for public use;
- reaching out to teachers, students, and the public through educational workshops, publications, and field trips that highlight the geology, landscape, and mineral resources of the state.

LeAnn Benner, information officer, and assistant Charlene Miles retrieve shipping information for a customer.

INFORMATION FOR THE PUBLIC

Library, Map Room, and Information Office

For many people who visit, write, or phone the ISGS, the primary contact is a staff member in the Information Office. Calls to the main phone number averaged nearly 1,000 per month. This year, more than 6,700 orders for maps and publications were received from 46 states. Thousands of complimentary copies of topographic map indexes, lists of publications, the ISGS newsletter *Geonews*, the booklet *Educational Resources for Teachers*, and other informational brochures, pamphlets, and flyers were sent out.

Distribution Statistics	FY 1993	FY 1994
ISGS publications	18,129	18,208
ISGS maps	6,667	7,232
USGS maps	29,603	22,200

The booklet, *Guide to the Use of the Mail Center*, was produced to help ISGS staff make efficient use of the services offered. The distribution of new maps and publications was boosted by systematically announcing their availability through press releases and announcements to the scientific community and private sectors. Copies are also available in libraries across the state.

The Earth Science Information Center responded to 627 requests for geodetic and general cartographic information. New or revised editions of 58 maps in the 7.5-minute (1:24,000 scale) quadrangle series were released this year. Another 34 maps are in

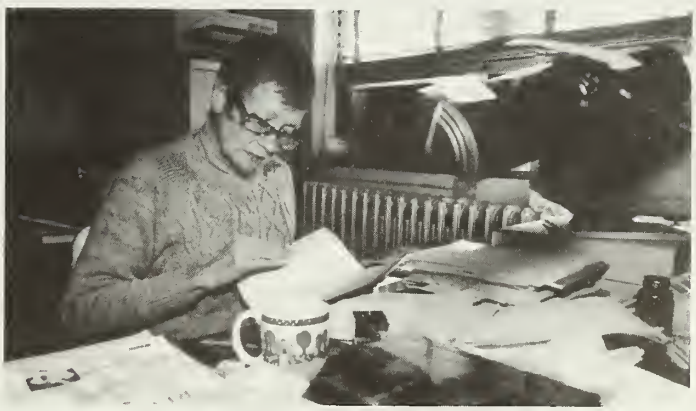
Larry Ritchie, printing specialist, uses the new sorter to collate books.

preparation for two USGS projects. Topographic maps are available for 46 of the 47 quadrangles that cover Illinois in the 30'60-minute series (1:100,000 scale). The last map in this series is expected to be completed in 1995. At the 1:100,000 scale, 71 county maps have been published. The 15-minute (1:62,000 scale) quadrangle series was discontinued by the U.S. Geological Survey.

The Library and Map Room staff provide vital reference services to ISGS staff and visitors. Journals, acquisition lists, and other materials are routed to notify staff of new publications and developments in their field. The library staff also verify literature citations in publications; compile bibliographies; run searches of bibliographies using online, CD-ROM and paper databases; and locate and borrow articles, books, and reports from libraries throughout the world. Much of this is being handled over the Internet, which links the ISGS library directly with worldwide resources. The library staff also prepared an exhibit, "Two Potential Land Use Problems in Illinois: Aquifer Contamination and Mine Subsidence," which was displayed during July in the Mueller Case in the main lobby of the University of Illinois Library.

In the Duplicating Shop, new sorting equipment is handling more types of paper and expanding the range of paper options for ISGS publications. The durability of bound publications has been increased by using a longer-lasting glue. All ISGS publications, except for four-color and oversize items, are duplicated in-house.

The Technical Information Officer aided in the dissemination of information by helping others to interpret and understand complex technical issues. Contacts with the news media and trade presses were supplemented by press releases, fact sheets, feature articles, and other informational materials. The Technical Information Officer also attended technical workshops, conferences, fairs, expositions, and other public events to help explain the results of ISGS efforts. Considerable assistance was also provided to other ISGS staff members in coordinating and arranging for displays or exhibits portraying ISGS research and services at many other events.



Suzanne Muckensturm, technical information officer, checks a press release announcing the fall ISGS geological field trips.

Publications, Graphic Arts, and Photography

High quality reports, maps, posters, slide presentations, field trip guide leaflets, and other materials to inform the public and the scientific community about ISGS research and service are the primary products of the Publications Unit (see table 2 and the separate volume *Publications*, which lists this year's releases). Speciality displays included two presentations on *The Great Flood of 1993* (including one for the State Fair) and an addition to the ISGS/INHS biodiversity display of a section called *The Good Earth*, which points out that essential nutrients in food originally come from rocks weathering into soil.

The editors, artists, and photographer all contributed significantly to the success of ISGS publishing efforts during the report year.

Table 2 Final publication projects[a]

	1990–91	1991–92	1992–93	1993–94
Bulletins	1	1	2	0
Circulars	2	2	3	3
Environmental Geology series	6	4	1	2
Cooperative Groundwater Reports	0	3	0	0
Illinois Mineral series	3	2	2	1
Illinois Petroleum series	2	2	3	4
Illinois Mine Subsidence Research (limited series)	0	0	0	1
Illinois Basin Studies (Consortium)	0	1	0	0
Special Report (new series)	-	1	0	1
Guidebook series	[b]2	1	0	1
Open File Series (including computer maps)	7	22	30	4
Directories of Coal Mines (new series)	-	-	1	0
Illinois Scientific Survey Joint Reports	0	0	0	0
Educational Extension field trip guides	4	4	4	4
Papers, book chapters, misc. text	21	15	18	10
Geogram	0	0	1	0
Large format maps, cross sections, stratigraphic columns	12	16	7	2
Posters, displays, major slide presentations	20	21	27	29
Administrative, miscellaneous, and *Geonews*	5	5	6	[c]5

[a] tally of completed projects (published or unpublished), which are not all equal in size and complexity.

[b] The guidebooks of 1989–91 were reprints of earlier publications. Guidebooks 24 and 25 are original works.

[c] Includes Annual Report with Annexes, GSL catalog, ENR critical trends report, and two *Geonews*.

Geologic Records and Samples Library

The Geological Records Library (GRL) is the repository for drilling records, as mandated by statute (Illinois Oil and Gas Act – 225 Illinois Compiled Statutes 725/6(4). The records are from oil and gas wells, water wells, engineering borings, and miscellaneous test holes. The database represents billions of dollars invested in Illinois for exploration and development of mineral fuels, groundwater, and engineering. The oil industry, coal industry, hydrogeologists, engineers, land-use planners, academic researchers, landowners, general public, and ISGS staff find the database a valuable resource.

The GRL staff continued to reduce two backlogs of well information and stepped up their effort to edit and update records contained in the ISGS database. The first backlog addressed was the review and filing of more than 650 logs donated by the Indiana Geological Survey and Ed Mckay, a retired geologist with extensive experience in oil exploration in the Illinois Basin. The GRL staff completed the check of existing records and inserted logs from the donated collection, if the original log was not already on file in the library. The second backlog, water well records for entry into the computerized data system, was reduced from 4,269 to 2,378 while staff kept current with the entry of new records each month. A total of 75,126 water well records has been added to the database since the backlog reduction program began in 1988, and the end of this process is in sight.

When folders return to the GRL for refiling, some are checked against the computer database and updated. Files selected for review against the database are typically those with new summary sheets or newly received plugging affidavits, or anomalous items brought to our attention by a scientist using the records for research. Through this process, we added permit numbers and issue dates, edited locations, and added appropriate log codes to more than 1,900 computer records.

The Illinois Department of Mines and Minerals (IDMM) is adding information from all plugged wells in Illinois to their computerized database. They also make copies of plugging affidavits available to the GRL to check against our records, a procedure established under an agreement to make our two well databases more consistent. Since the project began, the GRL has received more than 6,000 plugging affidavit forms, which represent an important opportunity to check ISGS records, make the files more complete, and update the computer database. Unfortunately, the plugging affidavits are arriving much more rapidly than GRL staff can review them. They are being stored according to county and location, and represent a growing backlog that will require future attention.

New well information continues to be acquired (table 3), although the total number of new logs declined slightly in FY 1994. Demands for GRL services remain high, as shown by the 10% increase in total mail processed. The number of phone calls received decreased slightly, but the number of visitors and files used by visitors and staff decreased substantially, reflecting the continued depressed state of oil and gas exploration and development.

The Geological Samples Library (GSL) has one of the largest collections in the United States. Mandated by statute (Illinois Oil and Gas Act-225 Illinois Compiled Statutes 725/6(4), this unique repository houses core and cuttings that represent billions of dollars invested in Illinois by petroleum, mining, and engineering companies. The collection attracts users from across the country, thus increasing the potential for in-state and out-of-state investment in Illinois. It also provides an essential material database for investigating environmental and resource issues.

The GSL office at the Natural Resources Studies Annex also houses a microfiche collection of well log information, back-up for the main GRL paper records.

Rick Hansen, technical assistant, sets up a computer in the financial office to receive e-mail.

Visitors and staff members referred to GSL files 160 times and studied 418 sets of samples or core in FY 1994. Visitors to the Annex facility represent a wide range of geologic interests, including independent consultants, major oil companies, universities, and government agencies. Of the 81 people who visited the GSL, 28% were from out-of-state, 30% were independent operators, and 58% represented companies, governmental organizations, or universities.

During FY 1994, 198 sets of well cuttings from 118 oil tests and 80 water wells were added to the permanent file. The additions, which represent 408,262 feet of drilling, increased the total drilling footage represented by the collections to 743,943,874 feet. The GSL files of 67,969 sets of well cuttings are stored in 109,913 boxes. Samples from an additional 37 oil and water wells await processing. The interval between initial receipt of a set of samples and their placement in the permanent collection is 1 month, a reduction of 2 months in processing time, as compared with that of last year.

Rock cores from oil and mineral borings increased the total drilled footage of core to 1,091,476 feet. Also during the report period, 94 cores representing an additional 30,088 feet of drilling were collected, examined, and processed into the permanent files that now include 13,895 sets of core.

Table 3 Annual Statistics of the Geological Records Unit

	1992-93	1993-94
SERVICE ACTIVITIES		
Total mail processed	26,660	29,530
Visitor days	894	818
Files used by public and staff	39,581	31,669
Phone calls	3,638	3,483
Copies		
continuous logs	5,432	3,867
single sheets	61,489	49,182
Total orders processed	2,115	1,751
Copies to state agencies/staff		
single sheets	13,932	3,389
logs	329	414
DATA ACQUISITION		
Basic Data		
Oil permits	1,410	816
Water permits	9,334	7,515
Water Task Force records	6,142	9,332
Plugging affidavits		
oil	1,098	8,130
water	2,986	2,365
Logs		
Electric logs	465	354
Micro logs	179	153
Radioactivity logs	572	447
Miscellaneous geophysical logs	57	90
Subtotal geophysical logs	1,273	1,044
Drillers' logs		6163
Drilling time logs	214	139
Company sample and core studies	49	28
Geologic tops	167	105
General data (completion data)	1,116	1,375
Water well and test hole logs	7,521	6,884
Miscellaneous	784	415
Total new logs received	11,185	10,053

CUMULATIVE TOTALS THROUGH JUNE 30, 1994

Collections	FY94	Totals
Processed drill-hole records	10,997	360,135
Books of processed drill-hole records	28	1,042
Skeleton logs		
(records prior to 1920)		17,920
Books of skeleton logs		40
Books of confidential logs		15
Books of out-of-state logs		14
Books of miscellaneous drill-hole records		9
Geophysical logs	1,044	134,637
Coal plugging	846	24,333

Educational Extension and Public Outreach

The ISGS prepares and distributes educational materials on the geology, mineral resources, and landscape of Illinois. Major educational extension functions include conducting four field trips each year, participating in selected teacher workshops, and responding to requests for educational materials and general inquiries from teachers, students, and the public.

Geological Science Field Trips Although originally designed to furnish teachers with background information and enrichment materials for classroom use, the four geological science field trips held each year are also popular with the public. A guidebook is prepared for each trip. Guidebooks for 94 previous field trips are available, and teachers may find them especially useful for planning their own trips.

Crystal Lake area, McHenry County The field trip held on September 11, 1993, in northeastern Illinois attracted 172 participants, including 34 teachers and 33 students. Most people taking the tour were acquainted with the glacial history of the area and the development of local mineral industries. Highlights of the trip included visits to two sand and gravel mining operations and stops where glacial features such as kettles, moraines, and kames were examined and discussed.

A caravan of geological field participants (right) heads toward Gresham Hollow Creek in Calhoun County. The crowd examines limestone bedrock along the creek.

Lawrenceville area, Lawrence County The second trip to southeastern Illinois on October 9, 1993, was slightly hampered by rain. An enthusiastic crowd of about 80 participants, including 12 teachers and 18 students, endured the dreary weather to visit several oil wells and hear explanations of geologic and engineering aspects of oil exploration and production.

Golconda area, Pope and Hardin Counties The first field trip of the spring returned to southeastern Illinois on April 23, 1994, and attracted 205 participants, including 21 teachers and 39 students. Participants were acquainted with the geology and historical development of the Illinois Fluorspar Mining District and visited a decorative sandstone quarry operation, an abandoned fluorspar mine, and a fossil collecting locality.

Hardin area, Calhoun and Greene Counties The last field trip of FY 1994 took place in west-central Illinois on May 21, 1994. The enthusiastic crowd of 158 participants included 29 teachers and 14 students—all interested in viewing the effects of the past summer's great floods. Also visited were a natural spring and a stream bed where rocks of Mississippian, Devonian, and Silurian age were exposed, affording an opportunity for everyone to collect fossils.

Public Outreach During the course of the year, the Educational Extension Unit distributed 7,100 copies of *Resources for Teaching Geology* to Illinois schools, wrote 164 letters in response to requests for educational materials, supplied 167 rock and mineral sets to educational institutions in Illinois, and distributed more than 600 copies of publications from the ISGS Educational Series to teachers and the public.

For Coal Awareness Week activities on October 19 in Carterville and October 21 in Springfield, the Educational Extension staff exhibited maps and samples of rocks and coal, and demonstrated a coal-cleaning process to 800 grade school students. The unit also participated in a Rivers Curriculum Training Workshop in Edwardsville on August 12, 1993, and a middle school meeting featuring a groundwater project in Rockford on November 19, 1993.

MAINTENANCE, OPERATIONS, AND DESIGN

Chris Wilson, maintenance specialist, drills a jaw chuck for a vise.

Well-equipped shops for woodworking, sheet metal fabrication, metal machining and welding, electronics repair and fabrication, automotive repair and maintenance make up the Maintenance, Operations, and Design Unit, which provides essential products and services for ISGS scientific, technical, and administrative staff. Special services include operation of the ISGS drill rig for field studies. The versatile craftsmen in the unit design, construct, maintain, and repair equipment and instruments, provide custom drilling services, and schedule and maintain the ISGS automotive and special vehicle fleet. They are responsible for the upkeep of the Shop and Equipment Building, the building housing the Clay Liner and Hydrogeology Field Laboratory, the new core storage facility, and the ISGS laboratories at the Natural Resources Building.

In the report year, the unit's staff spent approximately 65% of their time moving and relocating other ISGS staff during remodeling of the Natural Resources Building. They also stored office equipment temporarily and assisted staff members with hooking up computers and telephones, and setting up in their regular quarters or new locations.

Custom computer workstations, tables, desk organizers, bookshelves, and map cases are a specialty of the Woodworking Shop. Fabrication of a hinged wood lockable cover for an aluminum manhole, wooden bases for jack stands, and a wooden stand for a poster for the exhibit, *Biodiversity in Illinois*, were among the projects completed by the shop. The staff also painted file cabinets; repaired coat racks, chairs, and other wood furniture; rehung bulletin boards, maps, clocks and other items in newly finished rooms; and reworked shelving units and other furniture to fit rooms in which ceilings had been lowered.

The Machine Shop routinely designs and constructs special apparatus, such as the stand to display maps in the main lobby. Repair of crank handles and bearing assemblies

on two seismic line reels expedited seismic field work this past summer. In a special assignment, staff designed a jig and fabricated stainless steel packing for a packed flotation column for the scientists at the Applied Research Lab.

The Electronics Shop provides support in electrical/electronic maintenance and repair of scientific equipment and in coordination of site preparation for installation of new equipment throughout the ISGS. Installing and relocating telephones as well as running ethernet cabling are also Electronics Shop responsibilities. In this report period, the staff maintained and repaired air conditioners, electric motors, hot plates, electronic downhole logging equipment, display case lighting, neutron activation analysis equipment, and high-temperature furnaces. The staff's ability to repair field equipment for rapid turnaround to field use is of special value to the ISGS.

The ISGS drill rig and operator, in support of our scientific staff, worked on three projects for a total of 27 days in the field during this report period. Projects included continuous sampling and monitoring of well installations for proposed wetland mitigation and core drilling at a landslide site at Mounds, Illinois, and at the Arch of Illinois coal mine.

The Automotive Shop, which also handles dispatching and new vehicle requisitioning for the ISGS fleet, is responsible for servicing and keeping records for 27 ISGS and 66 INHS vehicles. This year, 179 lube and oil changes were completed and 114 vehicles cleaned in the garage's wash stall. When not busy with routine fueling, window and interior cleaning, and tire changing, the staff also installed trailer hitches, mud guards and other similar accessories, and kept track of vehicles taken to the State garage for major repairs. The staff also repaired portable generators and other motorized equipment used in the field, and took care of the ISGS tractor used for core handling and grass mowing.

Two new vehicles acquired for the ISGS fleet replaced two high-mileage vehicles, one with 114,000 miles and the other with 146,000 miles. The operational cost for the fleet this year was $.09 per mile. A strict maintenance schedule has kept costs to a minimum.

CAPITAL DEVELOPMENT BOARD PROJECTS

Major capital development projects are in progress at the ISGS or were recently approved by the General Assembly and signed into law by Governor Edgar. Burnham City Hospital, scheduled for purchase by the State in August 1994, will house the INHS after renovation. The ISGS will then expand into the space vacated by the INHS in the Natural Resources Building. Expansion of both Surveys into their new facilities will allow each to essentially meet the space requirements identified in an independent study of space needs conducted several years ago.

The $3.44 million renovation of the Natural Resources Building was initially approved in FY 1992. This is a joint project with the INHS to correct existing safety hazards and includes renovation work throughout the building. Construction

Jerry Glogowski, head of Administrative and General Services, supervised the year-long renovation of the Natural Resources Building to ensure construction went smoothly for the ISGS staff.

began in July 1993 and should be completed in September 1994. To utilize funds remaining after a successful low bid and meet the original program plan, a second project will be bid in September 1994 to replace the following: deionized water system, air conditioners, corridor floors, parking lot and driveway asphalt, garage doors, and a few outside doors in the Natural Resources Building. The stairwells will also be painted, some rooms will be reconfigured, and a paint booth will be added to the garage.

The $2.66 million laboratory upgrade for the INHS portion of the Natural Resources Building is scheduled for September bid. These laboratories will be fully usable for geological and geochemical research after the INHS moves to the renovated Burnham facility.

Other capital projects include the following:

- $952,000 total funding appropriated to rehabilitate the Applied Research Laboratory and upgrade the laboratories, beginning in FY95;
- an FY96 request for $470,000 to add on to the Annex Samples Library;
- an FY96 request for $135,000 to reconstruct the Applied Research Laboratory chimneys;
- an FY96 request for $235,000 to reconstruct the Natural Resources Building chimneys;
- an FY96 request for $217,000 to begin planning for the conversion of the west half of the Natural Resources Building for use by the ISGS.

Workmen (top right) drill a hole for an elevator shaft. A lone painter coats the lofty ceiling of a fourth floor office. A workman knocks out a door jamb for new elevator doors.

ACTIVITY MEASURES

All Illinois state agencies are required to provide activity measures as part of their annual budget presentations to the General Assembly. The ISGS uses a wide range of activity measures to gauge effectiveness in reaching the public with information and services. The measures are also helpful for indicating where research and service staff are applying their greatest energies, and whether we may need to adjust or reshape our program, budget, or organization (table 4).

Some annual measures are calculated from samples for selected months; for example, the number of long-distance telephone calls made by the staff is calculated from the number of calls billed to the ISGS during September 1993, and February and May 1994. The number of telephone calls and visitors recorded for the Information Office also have been based on samples counted for a short time. We believe these estimates are sufficient for measuring trends from one year to the next.

Table 4 Selected activity measures, 1993–94.

	Energy and Mineral Resources	Geochemistry	Geologic Mapping and Framework	Groundwater and Environmental	Technical and Administrative Services	Total FY94	Total FY93
Reports and maps published	121	44	78	57	12	312	291
distributed						25,440	24,796
Active projects	73	28	34	48	7	190	161
Visitors and office conferences	287	151	197	199	2,516	3,296	3,880
Letters and unpublished reports	498	36	122	616	368	1,640	1,809

Research Activities ISGS scientists reported 88 state-funded research and service projects in progress during the report year—14 fewer than last year. Of these, 32 were in the area of Energy and Mineral Resources, 18 in Geochemistry, 20 in Geologic Mapping and Framework Studies, 12 in Groundwater and Environmental Geology and 6 in Technical and Administrative Services. The Contracts and Grants Office also reported 102 active, sponsored research and service projects, a decrease of 9 projects since FY 93. Of the 102 projects, 41 were in the area of Energy and Mineral Resources, 10 in Geochemistry, 14 in Geologic Mapping and Framework Studies, 36 in Groundwater and Environmental Geology, and 1 in Technical and Administrative Services. The number of active state-supported projects reported by our scientists is down by 13 % compared to last year and the number of active sponsored projects reported is down by 8 %. These decreases apparently reflect the continuing effects of staff losses due to severe budget reductions during previous 3 fiscal years.

According to the count maintained by our grants and contracts administrative office, ISGS scientists submitted 62 proposals for external support of research investigations, 5 fewer than last year. Of these, 32 were submitted in the Energy and Mineral Resources area, 6 in Geochemistry, 8 in Geologic Mapping and Framework Studies and 16 in Groundwater and Environmental Geology. Many of the proposals we submit are prepared at the request of the sponsoring agency after preliminary negotiations are complete. Of the 62 proposals submitted in FY94, 35 were accepted by the sponsor and at least partially funded, 10 were rejected by the sponsor or withdrawn by the ISGS and 17 were still pending at the close of the fiscal year. This represents a success ratio of about 56 % for the proposals on which a decision had been made by the sponsor.

To transfer the results of our investigations and service activities to the users, ISGS scientists prepare numerous reports, maps and other documents for publication in our own series or in scientific and trade journals, proceedings volumes, and guidebooks compiled for scientific meetings. The authors and titles of these formally published documents are listed in the *Publications* volume of this annual report. The number of publications prepared this year, as shown in the table, is an increase of 2.6 % over the number published last year. Of these publications, 182 appeared in external journals and 130 in our own series. The area of Energy and Mineral Resources accounted for 121, 70 external and 51 internal; Geochemistry accounted for 44, 32 external and 12 internal; Groundwater and Environmental Geology accounted for 57, 37 external and 20 internal; Geologic Mapping and Framework Studies added 78, 41 external and 37 internal; and Technical and Administrative Services produce 2 internal and 10 external publications.

Information Responses To provide scientific information to those requesting it, the ISGS Library and Information Office reported sales of 7,264 copies of our books and pamphlets and 6,843 copies of our maps and cross sections. We also distributed 10,944 free copies of our books and 389 free copies of ISGS map products. The total of 25,440 documents distributed is 2.6 % greater than last year. The number of books and pamphlets distributed free fell by 3 % compared to last year, and the number of map products distributed free fell by about 23 %. However, the number of books and pamphlets sold rose 7.5 % and the sale of our maps and cross sections rose about 11 %. We also sold 18,382 copies of United States Geological Survey map products and distributed 3,818 free copies. The number of USGS maps sold this year is almost 14 % less than last year and the number of free copies distributed is 38 % less than last year. The reason for this drop is that in FY 93 the number of free copies distributed was unusually high due to a catch-up in a backlog of normal free distributions of newly published USGS map products to public officials. This year 1,791 reference requests were made to the Library/Map room.

During the reporting period, at least 3,296 visitors came to the Natural Resources Building to seek scientific advice, discuss proposed activities, examine our voluminous files of scientific data and purchase copies of publications. The total is about 15 % less than the number of visitors for FY 93 as shown in the table in this year's report. The total number of visitors to the Information Office fell from 1,857 in FY 93 to 1,619 in FY 94, a decrease of about 13 %. In FY 94, 818 visitors came to the Geological Records Library, compared to 894 in FY 93; 79 external visitors came to the Geological Samples Library in FY 94 compared to 122 in FY 93. Visitors to the Samples Library, both staff and external, examined 418 sets of samples up by 46 % from last year.

To respond to inquiries and conduct Survey business, our scientists reported sending out 1,640 letters and unpublished reports, 169 less than the total for last year. The reason for this drop may be attributed to the back-log of distribution for topographic maps, because a letter goes with each order. It is estimated that 33,120 long distance telephone calls were billed to the Survey for the year. The Information Office received 11,444 incoming phone calls in FY 94, down almost 21 % over last year's total. The number of phone calls last year, however, was up almost 26 %, possibly due to inquires related to the flood. Many of these incoming calls are directed to our scientists to provide a direct response to the caller. Telephone calls, facsimile transmissions of hand-written and typed materials, and computer messages and data transmitted directly through worldwide electronic networks are rapidly replacing letters and longer unpublished reports as the preferred means of transmitting unpublished information to our clients. Our current activity measures do not adequately track these new forms of communication. Demand for copies of well logs and other records distributed by our Geological Records Library (GRL) dropped from last year, apparently reflecting decreased activity within the oil industry. The GRL sold 3,867 continuous well log copies, 1,575 fewer than last year, distributed free 414 well log copies, and 49,182 single-page copies of geological

records (mostly water well logs). A total of 31,672 files were used in the Geological Records Library this year.

The Educational Extension Unit hosted 615 persons on the four geology field trips offered this year, of whom 33 % were students and their teachers. This year 167 rock and mineral sets were distributed and there were 574 other responses for educational materials. Some of the teacher workshops/displays and presentations this year were held during Coal Awareness Week, at a Junior College, and for the Rock and Mineral Club. Members of the ISGS staff had contact with the press on 47 occasions.

Identifications and Analyses To carry out their research and service projects during the reporting year, ISGS chemists completed at least 31,701 separate elemental determinations on 931 samples of rock, soil, brine and water. The chemists also ran 16,071 analyses on 203 coal samples. Rock strength tests, X-ray diffraction, soil composition and tempe cells were run on 583 samples and 9,646 determinations were made. Chemists tested for cesium-137 on 157 samples. The Isotope Geochemistry Laboratory performed 3,523 separate isotopic determinations on 2,136 samples, completed 207 carbon-14 age determinations and ran 294 analyses on coal samples. Twenty soil samples were subjected to extraction of clay hydroxyl for determination of ^{18}O and D. The Coal Analysis Laboratory completed 3,090 proximate, ultimate, hydrogen, sulfur and carbon analyses on 618 samples of coal and coal-related materials. On 16 chars, 32 surface area and TGA characteristic determinations were run. Also, determinations for adsorption of D-nitrophenol were made on 32 chars. On 25 samples, 750 determinations were run for fluorine in coal as part of a round robin with NIST. Pyrite characterization was conducted on 68 coal pellet samples. The organic geochemistry laboratories performed 468 gas chromatography determinations on 117 samples. The Environmental Geology Laboratory made 1,723 immunoassay determinations for pesticide occurrence in 448 samples. There were 1,143 scintillation counter analysis run for 526 samples of carbon-14 labelled atrazine. Other analyses included 320 analyses for nitrate on 64 samples, 180 analyses for chloride on 645 samples, and 403 scintillation counter analyses for tritium on 403 samples. Our scientists also completed 3,550 mineralogical determinations by x-ray diffraction, described 40 petrographic thin sections, and processed 37 samples of coal through the low-temperature ashing system for 11 determinations. There were 14,220 determinations run on 474 water samples. Particle size was determined on 97 samples.

In the field and laboratory, our scientists measured 95 stratigraphic sections, described 163 cores and studied 88 sample sets. Hand specimen identifications for others totaled 234. They examined volume changes in 27 samples from Lake Michigan. The palynology laboratory completed 11 biostratigraphic determinations on 27 samples. Geotechnical analyses included 24 instrumental particle size determinations on suspended sediments, 34 hydrometer tests, 52 sieve tests, 42 determinations of total suspended sediment content, 15 specific gravity tests, and 100 tests of rock strength. The reservoir engineering laboratory completed measurements of porosity and permeability on 20 core plugs, 200 minipermeameter measurements, 9 coreflow tests, 2 oil viscosity tests, 20 brine viscosity tests, 9 relative permeability measurements, 15 pilot-tube gas flow tests, 2 isochronal gas flow measurements, and 1 dead-weight test.

To explore for groundwater and for other purposes, our scientists ran 107 borehole geophysical logs at 70 locations compared to 62 logs at 53 locations last year. hey also conducted 48 electrical earth resistivity surveys. There were 3 seismic surveys conducted and 15 seismic spreads were logged in. The staff of the Digital Cartography and Spatial Analysis Section and other staff members throughout the ISGS wrote 375 custom computer programs in various languages, completed 37 data-entry projects of various sizes, digitized 212 maps, plotted 838 copies of various digital map files for internal use or external distribution, and generated 37 computer database subsets.

FINANCIAL REPORT

Fiscal Year 1994

Appropriatd Funds Of the appropriated FY94 funds totalling $5,668,000 (General Revenue Fund $5,276,500; Natural Resources Information Fund $250,400; Groundwater Protection Act [Hazardous Waste Research Fund] $141,100), expenditures from the General Revenue Funds (table F1) are approximately 100% of the appropriation. It is anticipated payment for an outstanding printing order and the repair of a piece of scientific equipment will be satisfied through the Court of Claims; the vendors were unable to deliver the product or service prior to the close of the lapse period. Transfers were made to cover shortfalls in medicare, contractual services, computer based research, and telecommunications. Expenditures in the Natural Resources Information Fund are running as projected (table F2): receipts are lower than required to expend the full appropriation amount. Expenditures in the Groundwater Protection Act (Hazardous Waster Research Fund) are 100% of the appropriation (table F3).

Allocated Funds Of the available allocated FY94 funds totalling $109,900, vouchered expenditures are 100% of the allocation for Lands Unsuitable for Mining Program (table F4).

Table F1 FY94 Financial Statement for the Illinois State Geological SurveyGeneral Revenue Fund: July 1, 1993 through September 30, 1994 ($ in thousands).

Line Item	Original appropriation for FY94	Transfers	Vouchered to date	Outstanding obligations to date	Balance available for FY94
Personal Services	$4,426.5	$0.0	$4,426.5	$0.0	$0.0
Retirement Contributions	235.7	0.0	235.7	0.0	0.0
Social Security Contributions	9.3	2.9	12.2	0.0	0.0
Contractual Services	90.2	4.0	94.2	0.0	0.0
Topomapping	17.4	0.0	17.4	0.0	0.0
Travel	35.7	(1.5)	34.2	0.0	0.0
Commodities	63.2	(13.5)	49.7	0.0	0.0
Printing	32.9	(1.2)	28.3	3.2	0.2
Equipment	34.7	(1.0)	33.7	0.0	0.0
Computer Based Research	47.9	1.6	49.4	0.0	0.1
Telecommunications	48.7	10.8	59.5	0.0	0.0
Operation of Automotive Equipment	31.6	(2.2)	29.4	0.0	0.0
GeoMapping - Other Expenses	22.5	0.0	22.5	0.0	0.0
Water Inventory & Aquifer Assess.	85.5	0.0	85.5	0.0	0.0
Repair & Maintenance-Major Equip.	78.4	0.1	78.2	0.3	0.0
Repair & Maintenance-Building	16.3	0.0	16.3	0.0	0.0
TOTALS	$5,276.5	$0.0	$5,272.7	$3.5	$0.3

Table F2 FY94 Financial Statement for the Illinois State Geological SurveyNatural Resources Information Fund: July 1, 1993 through September 30, 1994 ($ in thousands).

Line Item	Available appropriation for FY94	Transfers	Vouchered to date	Outstanding obligations to date	Balance available for FY94*
Lump Sum - Operating Expenses	$249.4	$0.0	$174.8	$0.0	$74.6
Refunds	1.0	0.0	0.0	0.0	1.0
TOTALS	$250.4	$0.0	$174.8	$0.0	$75.6

*NRIF receipts are insufficient to expend the full appropriation amount.
NRIF receipts July1,1993, through June 30, 1994, were $151.3

Table F3 FY94 Financial Statement for the Illinois State Geological SurveyGroundwater Protection Act: July 1, 1993 through September 30, 1994 ($ in thousands).

Line Item	Available appropriation for FY94	Transfers	Vouchered to date	Outstanding obligations to date	Balance available for FY94
Lump Sum	$141.1	$0.0	$141.1	$0.0	$0.0
TOTALS	$141.1	$0.0	$141.1	$0.0	$0.0

Table F4 FY94 Financial Statement for the Illinois State Geological SurveyLands Unsuitable for Mining Program: July 1, 1993 through September 30, 1994 ($ in thousands).

Line Item	Available appropriation for FY94	Available allocation for FY94	Vouchered to date	Outstanding obligations to date	Balance available for FY94
PROGRAM					
Personal Services	$61.2	$61.2	$61.2	$0.0	$0.0
Social Security Contributions	0.5	0.5	0.5	0.0	0.0
Group Insurance	10.3	10.3	10.3	0.0	0.0
Contractual Services	0.0	0.0	0.0	0.0	0.0
Travel	0.5	0.5	0.5	0.0	0.0
Computer Based Research	23.2	23.2	23.2	0.0	0.0
Telecommunications	0.0	0.0	0.0	0.0	0.0
Program Totals	$95.7	$95.7	$95.7	$0.0	$0.0
ADMINISTRATION					
Personal Services	$11.3	$11.3	$11.2	$0.0	$0.1
Retirement	0.0	0.0	0.0	0.0	0.0
Social Security Contributions	0.2	0.2	0.2	0.0	0.0
Group Insurance	2.3	2.3	2.3	0.0	0.0
Commodities	0.4	0.4	0.5	0.0	(0.1)
Administration Totals	$14.2	$14.2	$14.2	$0.0	$0.0
GRAND TOTALS	$109.9	$109.9	$109.9	$0.0	$0.0

Illinois Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION

Appendix A
RECOGNITION AND SERVICE

July 1993 to June 1994

HONORS AND AWARDS

Prizes, Medals, Honors, and High Offices

Michael L. Barnhardt received the Outstanding New Staff Member Award at the Survey's Annual Review and Poster Fair, November 16, 1993, in Urbana. Barnhardt, **Michael J. Chrzastowski, B. Brandon Curry, Sally L. Denhart, Jacquelyn L. Hannah, Cathleen Hobgood-Lemme, Dennis R. Kolata, M. W. Leighton, Nancy L. Martinkus, John M. Masters, Alan E. Metcalf, Michael V. Miller, Christopher J. Stohr, C. Brian Trask** and **Tonia J. Vaughn** received a "Reach Out Award" from the Governor's Office in October 1993 for volunteer efforts made during the 1993 summer flooding in Illinois along the Mississippi River and its tributaries.

Keros Cartwright received a Groundwater Science Award from the Illinois Groundwater Association for his "lifetime commitment to groundwater science, resulting in the improved protection of groundwater."

Chen-Lin Chou was awarded a Visiting Professorship by the National Science Council of Taiwan from September 1993-August 1994. During the year, he taught a graduate-level course in "Geochemistry of Energy Resources" at National Central University in Chungli, Taiwan, and conducted a research project on the Geochemistry of Miocene coals and shales in the Northern Basin of Taiwan.

Michael J. Chrzastowski received a letter of commendation in July 1993 from the Colonel of the Chicago District of the U.S. Army Corps of Engineers for contributions to the completion of the Illinois Shoreline Interim III Report that describes erosional problems along Chicago's lakefront.

Joan E. Crockett and **Donald F. Oltz** received Certificates of Merit from the Eastern Section of the American Association of Petroleum Geologists, September 20, 1993.

Heinz H. Damberger was named Adjunct Professor, Department of Geology, University of Illinois, effective May 1994.

Joseph A. Devera was awarded $800 for out-of-state travel from the U.S. Geological Survey's Volunteer Program in 1994.

Beverly L. Herzog was named one of five Women of Distinction for 1994 by the Green Meadows Girl Scout Council and was included in *Who's Who of Emerging Leaders in America*, 4th edition (1993-1994).

Nelson Kawamura received the Stanley D. Wilson Fellowship given to an Outstanding Student in Geotechnical Engineering at the University of Illinois, Urbana, on November 5, 1993.

Dennis R. Kolata was named Adjunct Professor, Department of Geology, University of Illinois, effective May 1994.

Anthony A. Lizzio and **Massoud Rostam-Abadi** received a cash award of $1,000 from Research Corporation Technologies for an invention disclosure, "Production of Commercial Grade Carbon Molecular Sieves from Illinois Coal for Air Separation by Controlled Nitric Acid Treatment."

E. Donald McKay was named Adjunct Professor in the Department of Geography at Northern Illinois University, DeKalb.

Duane M. Moore was an invited participant in the Penrose Conference: From the Inside and the Outside: Interdisciplinary Perspectives on the History of the Earth Sciences, March 19-21, 1994, in San Diego, CA.

Donald F. Oltz was selected as the Director and the ISGS was chosen as the Regional Lead Organization for the midwestern states of Illinois, Indiana, Kentucky and Michigan to manage the regional program of the Petroleum Technology Transfer Council, a nationwide organization comprised of petroleum producing companies.

James B. Risatti was an invited speaker on "Diversity of sulfate reducing bacteria in a saline microbial mat," at an Advanced Research Workshop on Structure, Development and Environmental Significance of Microbial Mats, sponsored by the North Atlantic Treaty Organization, September 27-October 1, 1993, in Arcachon, France, and is Adjunct Professor in the Department of Chemistry and Biochemistry at Southern Illinois University, Carbondale, and in the Department of Civil Engineering (Environmental Engineering Group) at Northwestern University, Evanston.

Nancy L. Rorick was awarded a Master of Science Degree in Geology at Southern Illinois University, August 1993, in Carbondale.

Massoud Rostam-Abadi was appointed an Adjunct Professor of Environmental Engineering at the University of Illinois, Urbana.

William R. Roy received the Distinguished Achievement Award at the Survey's Annual Review and Poster Fair, November 16, 1993, in Urbana.

SCIENTIFIC AND EDUCATIONAL CONTRIBUTIONS

Papers Presented at Scientific Meetings

Curtis Abert presented the poster, "Representing subsurface geology through GIS-produced slice maps," at the annual meeting of the Southeastern Section, Geological Society of America, April 7-8, 1994, in Blacksburg, VA. He also presented the poster, "Modeling subsurface geology with ARC/INFO and surface and volume modeling software" and an oral presentation, "Modeling, displaying, and mapping subsurface geology with GIS and volume modeling software" at the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

Robert A. Bauer presented the poster, "Summary of earthquake research and publications of the ISGS," at the Central United States Earthquake Consortium's meeting, December 16-17, 1993, in New Harmony, IN.

Michael L. Barnhardt presented the paper, "Spatial distribution of pesticides in soil at two Illinois agrichemical facilities," at the national meeting of the American Society of Agronomy and Soil Science Society of America, November 7-11, 1993, in Cincinnati, OH. He also presented the paper, "Site assessments and remediation alternatives for agrichemical facilities," at the Illinois Agricultural Pesticides Conference, January 5-7, 1994, at the College of Agriculture, University of Illinois, Urbana.

Richard C. Berg presented the paper, "Aquifer sensitivity assessment modeling at a large scale," at the annual meeting of the Southeastern Section, Geological Society of America, April 7-8, 1994, in Blacksburg, VA.

Chusak Chaven presented a poster on a bibliographical system data base at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana. At this meeting, **Mei-In Melissa Chou** presented the paper, "Sulfur Removal from High-Sulfur Illinois Coals by Low-Temperature Perchloroethylene Extraction."

Chen-Lin Chou presented the following papers, "Behavior of sulfur and chlorine in coal during combustion and boiler corrosion," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana and "Application of synchrotron X-ray fluorescence microprobe analysis in trace element geochemistry," at the annual meeting of the Geological Society of China, March 28-29, 1994, in Taipei, Taiwan.

Michael J. Chrzastowski made a presentation on the Holocene evolution of the Illinois coast at the final meeting of the International Geological Correlation Programme Project 274 (Coastal Evolution in the Quaternary) held September 15, 1993, in Oostduinkerke, Belgium. He gave a slide show on the geologic impacts of the 1993 flooding in Illinois for a meeting of the Nature of Illinois Foundation, October 4, 1993, in Champaign and at the Governor's Workshop on the Great Flood of 1993 on March 1, 1994, in Springfield. Chrzastowski made a presentation on Illinois' coastal evolution at the bi-monthly meeting of the North Central Section of the Association of Engineering Geologists, February 15, 1994, in Chicago. At the annual meeting, April 29, 1994, in Kalamazoo, MI, of the North-Central Section of the Geological Society of America, he gave a presentation on the past, present, and future of coastal processes along the Illinois coast of Lake Michigan.

Dennis D. Coleman presented a paper, "Identification of landfill methane using carbon and hydrogen isotope analysis," at the 16th International Madison Waste Conference, September 22-23, 1993, in Madison, WI.

Heinz H. Damberger presented the paper, "Adoption of a 'linear' coalification scale improves interpretability of regional coalification maps," at the annual meeting of the Geological Society of America, October 24-28, 1993 in Boston, MA.

B. Brandon Curry presented the papers, "Positive correspondence between the completeness of late Quaternary fossiliferous lacustrine succession in Illinois and the basin index" and "^{14}C and ^{10}Be evidence for no incursion of the Lake Michigan Lobe in northern Illinois from ca. 170 to 25 ka," at a meeting of the North-Central Section of the Geological Society of America, April 27 and 28, 1994, in Kalamazoo, MI. He also presented the poster, "Unusual stable isotope (C,O) values of ostracodal calcite from Sangamonian lacustrine sediment in Raymond Basin, Illinois," at the 13th biennial meeting of the American Quaternary Association, June 19-22, 1994, in Minneapolis, MN.

Joseph A. DeBarr presented the paper, "Integrated Methods for Production of Clean Char and Its Combustion Properties," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana.

Ilham Demir presented the paper, "Evaluation of the surface properties of Illinois Basin coals," at the 206th National Meeting of the American Chemical Society, August 22-27, 1993, in Chicago; gave a poster presentation, "Characterization of Available Coals from Illinois Mines," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana, and presented another paper, "Trace Elements in Illinois Coals Before and After Conventional Coal Preparation," at the 207th National Meeting of the American Chemical Society, March 13-17, 1994, in San Diego, CA.

William S. Dey presented the paper, "The Occurrence of Agricultural Chemicals in Rural, Private Wells in Illinois: New Insights from a Pilot Study," at the Midwest Groundwater Conference, October 5-6, 1993, in Champaign.

Gwen L. Donnals presented the poster, "Development and Evaluation of High-Surface-Area Hydrated Lime for SO_2 Control," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana.

Gary B. Dreher presented the paper, "Laboratory studies of fluidized bed combustion residues in mixtures with coal slurry solids," at a meeting on Management of High-Sulfur Coal Combustion Residues: Issues and Practices, April 5-7, 1994, in Springfield.

Leon R. Follmer presented a paper, "A scale for judging degree of soil and paleosol development," at the annual meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA, and took the post-meeting field trip to study the glaciated features of the White Mountains in New Hampshire.

Wayne T. Frankie presented a paper and an exhibit by the same title, "Production Potential of New Albany Shale in the Illinois Basin," at a meeting of the Illinois Geological Society, September 9, 1993, in Mt. Vernon and a poster, "Gas Potential of New Albany Shale in the Illinois Basin," at a meeting of the Eastern Section of the American Association of Petroleum Geologists held September 19-21, 1993, in Williamsburg, VA.

Christine S. Fucciolo presented a paper, "Hydrogeologic Characterization of Illinois Wetlands," at the annual meeting of the North-Central Section of the Geological Society of America, April 27-28, 1994, in Kalamazoo, MI.

John P. Grube, Zakaria Lasemi, and **Janis D. Treworgy** lectured on "Chasing the Warsaw" at the annual meeting of the Illinois Oil and Gas Association, March 3, 1994, in Evansville, IN.

Keith C. Hackley presented the paper,"Release of Organic, Pyritic, Elemental and Sulfate Sulfur during Temperature-Programmed Pyrolysis of Illinois Basin Coals," at the 5th International Conference on Processing and Utilization of High-Sulfur Coal, October 24-28, 1993, in Lexington, KY.

Ardith K. Hansel presented the poster, "Subglacial till of deformation origin from the last glacial episode in central Illinois," at the annual meeting of the Geological Society of America (GSA), October 25-28, 1993, in Boston, MA, at which she attended Quaternary sessions and a meeting of the GSA Quaternary Geology and Geomorphology Division Management Board Committee. She also presented a paper, "Evidence for subglacial deformation at the Clear Creek Section in central Illinois," at the Midwest Glaciology Meeting, April 22, 1994, in Columbus, OH.

Manoutchehr Heidari presented a paper, "Determination of horizontal hydraulic conductivity anisotropy in homogeneous aquifers: a nonlinear least squares approach," at the 38th Annual Midwest Groundwater Conference, October 6-8, 1993, in Champaign and a talk on the "Automated parameter estimation of regional groundwater aquifers" at the meeting of the American Society of Agricultural Engineers, June 19-22, 1994, in Kansas, City, MO.

Kathleen M. Henry presented the poster, "Bibliographic Information Database in Illinois Basin Coal Sample Program" at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana.

Beverly L. Herzog presented the paper, "Effect of Analysis Method on Slug Test Results," at the Midwest Groundwater Conference, October 6-8, 1993, in Champaign. She also co-chaired the Planning Committee for the conference with the duties of inviting plenary session speakers, reviewing abstracts, helping with planning and organization of programs, helping with registration, presenting the welcoming address and chairing a session. Herzog also presented the paper, "Groundwater Resources Evaluation of West McLean, Eastern Tazewell Counties, Illinois," at the Illinois Groundwater Association's meeting, March 1994, in St. Charles. In addition, she was a panelist discussing "Are Fractured Unlithified Aquitards Good Waste Disposal Sites or Not?" at the Geological Society of America's Penrose Conference on Fractured, Unlithified Aquitards, June 20, 1994, in Racine, WI and took the field trip in conjunction with the meeting, June 17, to tills along the Michigan shoreline near Racine.

Randall E. Hughes presented the following papers: "Geochemical controls on the formation of members of the kaolin group," at the 10th International Clay Conference, July 18-23, 1993, in Adelaide, Australia; "Kaolins: Hill and Dale," at the 30th annual meeting of the Clay Mineral Society, September 25-30, 1993, in San Diego, CA; "Berthierine pipestones of Native Americans in the Mid-continent," at the annual meeting of the Illinois Academy of Science, October 15, 1993, in Carbondale; and "Clay resources associated with lower Pennsylvanian coals," at the Symposium on Economic Resources of the Lower Pennsylvanian of the Illinois Basin, November 10-11, 1993, Bloomington, IN.

Donald A. Keefer presented papers: "Characterization of Tracer Movement as a Function of Pore Morphology," at the Midwest Groundwater Conference, October 6-8, 1993, Champaign; "Tile-Effluent Monitoring Techniques for Characterizing Agrichemical Leaching," at the annual meeting of the Soil Science Society of America, November 7-12, 1993, in Cincinnati, OH; and "Characterization of the Field-Scale Preferential Transport of Solutes," at Fourth Annual Conference of the Illinois Groundwater Consortium, March 23-24, 1994, in Makanda. He also presented a poster, "Observations of Tracer Movement through a Highly Fractured Unsaturated Zone," at the Penrose Conference on Fractured Unlithified Aquitards: Origins and Transport Processes, June 15-20, 1994, in Racine, WI.

Ivan G. Krapac presented a paper, "Pesticides in Soils at Agrichemical Facilities in Illinois," at the Illinois Agricultural Pesticides Conference, University of Illinois, January 5-6, 1994, in Urbana.

Zakaria Lasemi presented the paper, "Depositional history of the Mississippian Ullin and Fort Payne Formations in the Illinois Basin," at a meeting of the North-Central Section, Geological Society of America, April 28-29, 1994, in Kalamazoo, MI; and gave two poster sessions—"Development of Waulsortian mounds and hydrocarbon-bearing flanking facies in the middle Mississippian of the Illinois Basin" with **Janis D. Treworgy** and "Temporal trends in the mineralogy of phanerozoic micrite precursors"— at the annual meeting of the American Association of Petroleum Geologists (AAPG), June 12-15, 1994, in Denver, CO. At the AAPG meeting, he attended a short course, "Geologic Log Interpretation," sponsored by the Society for Sedimentary Geology.

Hannes E. Leetaru presented the following papers, "Improved oil recovery in mature fields through reservoir characterization and management," at the International Conference of the American Association of Petroleum Geologists, October 17-20, 1993, in The Hague, The Netherlands, and "Seismic character analysis of a mixed siliciclastic-carbonate reservoir," at the annual meeting of the American Association of Petroleum Geologists, June 12-15, 1994, in Denver, CO.

Anthony A. Lizzio presented the following papers: "Production of Carbon Molecular Sieves from Illinois Coal," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana, which was repeated at the summer national meeting of the American Institute of Chemical Engineers (AIChE), August 17, 1993, in Seattle, WA, and "The Production and Use of High Value Carbons," at a meeting of the Illinois Coal Advisory Committee, May 16, 1994, in Champaign. At the AIChE, he led the symposium, "The Use of Carbon-Based Materials in Gas Separation, Purification and Cleanup."

John M. Masters presented the poster, "High-Calcium Limestone Prospect in Thebes Gap, Southernmost Illinois," at the 30th Forum on the Geology of Industrial Minerals, May 23-25, 1994, in Halifax, Nova Scotia, Canada. In conjunction with the meeting, he attended field trips, May 22 from Fredericton to Halifax, visiting granite dimension stone, and silica and potash deposits, and May 26-27 from Halifax to Fredericton, visiting a gypsum quarry, a silica sand deposit, aggregate quarry, wallboard plant, gypsum quarries, and an underground salt mine/processing plant.

E. Donald McKay presented the paper, "Geologic Maps in Siting Landfills and Other Facilities, at the Urban and Regional Information Systems Conference, July 25-27, 1993, in Atlanta, GA.

Melisa M. McLean presented the paper, "Using GIS to Map Stratigraphic Units in McLean County, Illinois," at the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

Michael V. Miller presented "Guidelines for Hydrological and Water Quality Monitoring of Mitigation Wetlands," at the annual meeting of the Society of Wetland Scientists, May 31-June 3, 1994, in Portland, OR.

James J. Miner presented the poster, "Hydrogeologic Characterization of Illinois Wetlands," at the annual meeting of the North-Central Section of the Geological Society of America, April 27-28, 1994, in Kalamazoo, MI.

Duane M. Moore presented a paper, "Science education and the history and philosophy of science: A place for clay mineralogy?" at the 30th Annual Meeting of the Clay Mineral Society, September 25-30, 1993, in San Diego, CA, during which he took a field trip studying Eocene and Oligocene Bentonites in southwest San Diego County. At this meeting and at the 10th International Clay Conference, July 18-23, 1993, in Adelaide, Australia, he showed two videos he produced and directed on a conversation with R. E. Grim and an interview with Walter Keller. Moore also attended a field trip—Coorong for recent dolomite sedimentation, following the International Clay Conference.

W. John Nelson presented the poster, "Cat Creek anticline, recurrent faulting and oil migration," at the annual meeting of the American Association of Petroleum Geologists, June 12-15, 1994, in Denver, CO, and participated in an associated field trip, "A new look at the Laramide orogeny in the Shirley Mountains, Freezeout Hills, and Hanna Basin, Wyoming. For the Montana Geological Society's (August) 1993 Field Conference in central Montana, he helped prepare the road log, wrote an article in the guidebook and was a stop leader.

Rodney D. Norby presented the paper, "Conodont biostratigraphy of the Brandon Bridge and associated Silurian Waukesha *Lagerstatte* in Waukesha County, Wisconsin," at the annual meeting of the North-Central Section of the Geological Society of America, April 28-29, 1994, in Kalamazoo, MI. He also made a presentation on "Chasing the 'Warsaw' in the Illinois Basin" at the annual meeting of the Illinois Oil and Gas Association, March 2-3, 1994, in Evansville, IN.

Donald F. Oltz made a presentation on "The Midwest Region of the Petroleum Technology Transfer Council" at the annual meeting of the Independent Oil Producer's Association, June 23, 1994, in Evansville, IN.

Samuel V. Panno presented the paper, "Mapping of Karst Areas of Illinois II: Pesticide Contamination of Karst Aquifers of Southwestern Illinois," at the Fourth Annual Conference of the Illinois Groundwater Consortium, March 23-24, 1994, in Makanda.

Russel A. Peppers presented a poster, "Distribution of boghead algae in Illinois Basin coal beds," at the Symposium on Economic Resources of the Lower Pennsylvanian of the Illinois Basin of the Tradewater Working Group, November 10-11, 1993, in Bloomington, IN.

David M. Rapp presented the results of his research on coal at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana.

Matthew H. Riggs presented the paper, "Statewide Screening for a Low-Level Radioactive Waste Disposal Facility in Illinois," at the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

James B. Risatti presented the paper, "Fermentable carbon loading as a key to acetoclastic methanogenesis," at the Geochemical Session of the annual meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA.

Nancy L. Rorick presented the paper, "Use of a groundwater model to determine the feasibility of a wetlands mitigation site in East Hannibal, Illinois," at the 38th Annual Midwest Groundwater Conference, October 6-8, 1993, in Champaign.

Massoud Rostam-Abadi presented a paper, "Production of carbon molecular sieve from Illinois coal," at the 1993 Summer National Meeting of the American Institute of Chemical Engineers, August 15-18, 1993, in Seattle, WA, at which he also organized three sessions and co-chaired one on the "Use of carbon-based materials in gas separation, purification and cleanup;" gave a poster, "Development and advancement of high-surface-area hydrated lime," and a paper, "Combustion properties of coal-char blends: Nox emission," both at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana; presented a paper, "Development and application of high-surface-area hydrated lime for control of acid gas emissions," at the Spring National Meeting of the American Institute of Chemical Engineers, April 17-21, 1994, in Atlanta, GA; and made a presentation on "High-surface-area hydrated lime: Update," at a meeting of the Coal Advisory Committee, May 13, 1994, in Urbana.

William R. Roy presented the following papers: "Pesticides in soil materials at agrichemical facilities: What is 'contamination?'" at the 1994 Illinois Agricultural Pesticide Conference, University of Illinois, January 5-6, 1994, in Urbana; "Fate and Transport of Atrazine in Fill Materials at Agrichemical Facilities: Second Year Summary" and "Evaluation of pesticide releases from retail agrichemical facilities during the 1993 flooding in Illinois," both at the Fourth Annual Conference of the Illinois Groundwater Consortium, March 23-24, 1994, in Makanda; and a poster, "Geochemistry of FBC Waste-Coal Slurry Solid Mixtures," at the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana.

Gary L. Salmon presented the following papers: "Flash Pyrolysis-GC/MS Investigation of Maceral Concentrates Separated from Miocene Monterey Fm. Kerogen and Eocene Indonesian Coal," at the 211th National Meeting of the American Chemical Society, August 22-26, in Chicago; "Geochemical Comparisons at Constructed Urban Wetlands: Changes in Biological Isomer Configurations and Distributions in Buried Sediments" and "Geochemical Assessment of a Wetland Mitigation Site: Seasonal and Spatial Trends during the First Two years of a Monitoring Program," both at the Third Symposium on Biogeochemistry of Wetlands, June 1994, in Orlando, FL.

Beverly Seyler presented the paper, "The Necessity for Integrating Geologic and Engineering Data in a Comprehensive Program of Reservoir Management," at the Fourth Annual Archie Conference, November 1-3, 1993, in Houston, TX.

Lisa R. Smith presented the paper, "Interagency and Private Sector Data Exchange for Response to and Documentation of the Flood of 1993" and the poster, "Preliminary Mississippi River Inundation Map," at the GIS in Illinois 1993 Conference, November 9-10, 1993, in Arlington Heights.

Barbara J. Stiff presented the poster, "Re-evaluation of the Deglaciation of a Portion of the Illinoian Till Plain in West-Central Illinois," at the annual meeting of the Geological Society of America (GSA) at which she also attended a course, "GIS and the Geosciences," October 23-28, 1993, in Boston, MA, and a paper,"Somehow We Have Overlooked the Obvious--Database Integrity Standards, " at the GIS in Illinois Conference, November 9-10, 1993, in Arlington Heights.

Christopher J. Stohr presented the following papers, "t-Test for Classification of Depressions in Landfill Covers by Airborne Thermal Infrared Imagery" and "Experiences with Two Types of Inexpensive Frame Grabbers and a Commercial Video Cassette Recorder for Image Processing of Remote Sensing Data," in a Symposium on Remote Sensing in Solid and Hazardous Waste Management, which he organized and chaired, at the 36th annual meeting of the Association of Engineering Geologists (AEG), October 11, 1993, in San Antonio, TX. He also served as Guest Editor for a special issue of *Photogrammetric Engineering and Remote Sensing* in which papers were published from the symposium. **Wen-June Su** also presented a paper, "Landslides in southern Illinois triggered by earthquakes in the New Madrid Seismic Zone" and took a short course on the "Safety Evaluation of Existing Dams" at the 36th annual meeting of AEG.

Colin G. Treworgy presented the paper," Status of Coal Availability Studies in Illinois," at the annual meeting of the U.S. Coal Availability/Recoverability Studies, June 15-16, 1994, in Denver, CO.

Emmanuel O. Udegbunam presented a paper, "Reservoir Characterization and Evaluation of Oil Productivity of Mississippian Cypress Reservoirs of Lawrence Field," at the Fourth Annual Archie Conference, November 1-4, 1993, in Houston, TX.

Hong Wang presented the following papers: "Reconstruction of the changing climate and habitat of the Chinese Loess Plateau since 120,000 BP using oxygen and carbon isotopic analysis of the soil," and "Multi-pedogenic model for soil stratigraphy on the Chinese Loess Plateau and application of a soil development scale," at the International Paleopedology Symposium, August 6-12, 1993, in Monticello.

C. Pius Weibel presented the following papers: "Upper Pennsylvanian strata in the Illinois Basin (USA) suggest compressional effect of Appalachian-Ouachita Orogeny," at the Carboniferous to Jurassic PANGEA Conference of the Canadian Society of Petroleum Geologists with Global Sedimentary Geology Program, August 15-19, 1993, in Calgary, Alberta, Canada; "Use of a Constant Electrode-Separation Resistivity Survey to Locate Buried Cavities Associated with Regolith-Collapse Sinkholes in Southern Illinois," at the 27th annual meeting of the North-Central Section of the Geological Society of America, April 28-29, 1994, in Kalamazoo, MI; and "Geologic/Urban Planning for the Proposed New Site of the Mississippi River Flood-Devastated Town of Valmeyer, Illinois," at the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

Scientific Workshops/Training Courses Taught or Attended

Curtis Abert participated in Dynamic Graphics EarthVision training, March 28-31, 1994, in Alameda, CA.

Phyllis L. Bannon and **Anne L. Erdmann** participated in the Illinois Department of Transportation's (IDOT) in-house training seminar on Underground Storage Tank Regulations: Public Act 88-476, November 18, 1993, in Springfield. **Bannon, Michael A.**

Phillips, and **Kelly A. Rust** participated in IDOT's executive awareness session on asbestos, March 23, 1994, in Springfield.

Robert A. Bauer made a presentation on seismic activity in the Midwest and what may be expected in damages in various parts of the state at the Post-Earthquake Safety Evaluation of Buildings Workshop, August 12, 1993, in Chicago. The workshop, held by the Federal Emergency Management Agency, was for structural engineers who would be performing post-earthquake safety evaluations on buildings in affected areas. The same type of information was provided at short courses held by the Illinois Emergency Management Agency (IEMA) on "Post-Earthquake Building Evaluations," April 21, at Lake Shelbyville and April 22, 1993, in Marion. He participated in the U.S. Geological Survey's (USGS) workshop, November 9-10, 1993, in Little Rock, AR, concerning "Post-Earthquake Data Collection." Bauer participated in a two-day meeting of the Central United States Earthquake Consortium (CUSEC) of State Geologists, December 16-17, 1993, in New Harmony, IN, and a one-day meeting of the group, March 23, 1994, in Little Rock, AR, discussing tasks to be accomplished under the next proposed grant from the USGS for seismic zonation in the Midwest. On May 25, 1994, a 16-county earthquake exercise was conducted by IEMA, for which he helped produce the earthquake scenario. The magnitude of the event and its impact based on geological materials were developed at the ISGS. From the scenario map, a list of "incidents" or "events," produced by this "earthquake," were developed for each participating county. Preceding the event, Bauer presented information, May 11, on seismicity and earthquake effects in the Midwest to participants in the exercise. He was also a member of the organizing committee, co-chaired several sessions of, and reviewed papers for selection for the First North American Rock Mechanics Symposium, June 1-3, 1994, at the University of Texas, Austin.

Michael L. Barnhardt participated in and was a writer of a document for the North Atlantic Treaty Organization (NATO) for the Fourth Working Group Meeting of the Committee on the Challenges of Modern Society (NATO) held November 30-December 5, 1993, in New Orleans, LA. That committee is doing a pilot study on the effects of large construction projects on the environment for which Barnhardt also participated in a writing workshop, February 1-3, 1994, at the U.S. Army's Construction Engineering Research Laboratories (CERL), Champaign.

Ross D. Brower assisted with the planning and operation of and moderated a session of the Midwest Groundwater Conference, October 6-8, 1993, in Champaign. He is historian of the conference. Brower and **Beverly Herzog** participated in a water treatment technology seminar, November 4, 1993, given by Layne-Western Company, Inc., in Bloomington.

Richard A. Cahill participated in a seminar of the U.S. Army Corps of Engineers on "Dredged Material Assessment and Management," held July 20-22, 1993, in Ann Arbor, MI, and audited the Department of Public Health's course CHLTH-375 in Geographical Epidemiology at the University of Illinois, Spring 1994.

Heinz H. Damberger, Dennis R. Kolata, and **Colin G. Treworgy** participated in the Symposium on Economic Resources of the Lower Pennsylvanian of the Illinois Basin of the Tradewater Working Group held on November 10-11, 1993, in Bloomington, IN.

Joseph A. DeBarr completed three academic courses—Fluid Mechanics, TAM 235; Air Resources Engineering, CE 349; and Air Dispersion Modeling, CE 345—from January through May 1994, at the University of Illinois in Urbana.

F. Brett Denny completed the graduate school's Wetlands course during 1994 at Southern Illinois University, in Carbondale.

William S. Dey completed two courses--Groundwater, CE 357, September-December 1993 and Soil Fertility and Fertilizers, SOILS 303, January-May 1994--at the University of Illinois, Urbana.

Roberta J. Farrell completed two courses--Geographic Information Systems, UP 394, September-December 1993 and Advanced Geographic Information Systems, UP 494, January-May 1994--at the University of Illinois, Urbana. Farrell, **Christine S. Fucciolo, James W. Geiger, Mark A. Hart, Gregory A. Kientop, Robert A. Lambert, Alison M. Meanor, James J. Miner, Nancy L. Rorick,** and **Kelly A. Rust** completed a 24-hour Hazardous Waste Site Worker Training Program, December 7-9, 1993, at the Institute of Labor and Industrial Relations, Urbana.

Leon R. Follmer attended workshops organized by the Soil Conservation Service on advances in soil science, July 21, 1993, in Springfield and January 12, 1994, in Urbana. At the January event, he lectured on the application of loess research to soil survey interpretations. He was a panelist, March 26, 1994, at a Tropical Soil Workshop organized by the Geography Department at the University of Illinois, Urbana.

Wayne T. Frankie participated in a meeting on the Mass Balance Project of the Illinois Basin Consortium and the U.S. Geological Survey, April 12, 1994, in Bloomington, IN. He also presented an overview of publications and resources available through the Educational Extension Unit to attendees of a Rivers Curriculum Training Workshop, August 10, 1993, in Edwardsville. In addition, Frankie participated in the session on "Preparing Successful Grant Proposals to Fund Curriculum Innovation in the Geosciences" at the annual meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA.

Christine S. Fucciolo, Michael V. Miller and **James J. Miner** participated in a seminar for professionals, "Wetlands and the Law: A Practical Guide," presented by The Morton Arboretum, September 10, 1993, in Hoffman Estates. Fucciolo and Miner also attended a seminar and field trip on "Iowa's Fen Wetlands," presented by Iowa State University's Cooperative Extension, May 12, 1994, in Olewein, IA.

James W. Geiger completed the Weather Satellite Systems and Photo Interpretation Course given September 13-24, 1993, at Keesler Air Force Base, MS.

Keith C. Hackley and **Samuel V. Panno** completed a short course on "Municipal Landfills and Ground-Water Quality," sponsored by the American Society of Civil Engineers, September 29-30, 1993, in Downers Grove.

Dennis J. Haggerty attended a workshop covering environmental regulations and the impact of new environmental laws taking affect in 1995 at a meeting of the Midwest Section of the Society of Petroleum Engineers, March 1994, in Pontiac.

Beverly L. Herzog completed a short-course showcase by Engineering Education Enterprises, January 25-28, 1994, in Orlando, FL. She discussed "Current Developments in Groundwater Science" at the workshops on "Groundwater Protection - Local Government Actions" held April 26 in Peoria and April 28, 1994, in Fairview Heights. In addition, Herzog co-taught the groundwater portion of a short course entitled "Fundamentals of Environmental Sampling" for Engineering Education Enterprises, May 11-13, 1994, in Columbus, OH.

Russell J. Jacobson co-lead a two-week course in dinosaur field vertebrate paleontology, August 1-14, 1993, in Sundance, WY, and taught a one-day orientation course, April 30, 1994, at the University of Illinois, Urbana, for participants in the August 1994 dinosaur dig in the Morrison Formation near Sundance, WY.

Donald A. Keefer completed two short courses: "Probability, Statistics and Geostatistics for Environmental Professionals," sponsored by the National Ground Water Association, August 9-11, 1993, in Schaumburg; and "Fractured Rocks: Characterization, Flow and Transport," sponsored by Environmental Education Enterprises, February 28-March 2, 1994, in Tucson, AZ. **Edward Mehnert** also attended the short course in Tucson.

Myrna M. Killey participated in a Groundwater Protection Workshop, March 24, 1994, in Champaign.

Dennis R. Kolata made presentations on the "Evolution of the Illinois Basin: An Overview," to the Geology Department at the University of Iowa, September 3, 1993, and on the "Geology of the Illinois Basin" to the Board of Natural Resources and Conservation, November 30, 1993. He also participated in a seminar on "Seismic Stratigraphy of the Illinois Basin," sponsored by the Illinois Geological Society, March 8, 1994.

Robert A. Lambert completed the following courses at the University of Illinois, Urbana: Land and Society: History, Theory, and Problems, Landscape Architecture 417, fall 1993; Research in Historical Geography, Geography 463, fall 1993; American Intellectual and Cultural History, History 371, fall 1993; and Symbolic and Interpretative Anthropology, Anthropology 380, spring 1994.

David R. Larson and **Nancy L. Rorick** attended a short course on "Applying Groundwater Flow Modeling Techniques to Field Problems," sponsored by Environmental Education Enterprises, February 28-March 3, 1994, in Tucson, AZ.

Timothy H. Larson participated in the "Symposium on Applications of Geophysics to Engineering and Environmental Problems," sponsored by the Environmental and Engineering Geophysical Society, March 27-31, 1994, in Boston, MA.

Anthony A. Lizzio organized a two-day Carbon Materials and Properties Workshop with Harry Marsh of Southern Illinois University at the University of Illinois, Urbana.

E. Donald McKay gave a talk, "ISGS Map Production and GIS Use for Response to the Great Flood of 1993," at the Fourth State Mapping Workshop, sponsored by the Mid-Continent Mapping Center of the National Mapping Division, the U.S. Geological Survey, September 21-23, 1993, in Rolla, MO. He also organized three sessions with 10 speakers on the Use of the GIS for Response to the Great Flood of 1993 for a GIS in Illinois Conference, November 9-10, 1993, in Arlington Heights. McKay gave "The ISGS Response to the Flood of 1993" as part of the Illinois State Report to the Association of State Wetland Managers and the Association of State Floodplain Managers meeting on the Flood of 1993, January 13-14, 1994, in St. Louis, MO. In addition, he participated in the Governor's Conference on the Great Flood of 1993, held on March 1, 1994, in Springfield.

Melisa M. McLean and **Lisa R. Smith** attended the Fourth State Mapping Workshop, sponsored by the Mid-Continent Mapping Center of the National Mapping Division, the U.S. Geological Survey, September 21-23, 1993, in Rolla, MO.

Alison M. Meanor completed courses in Topics in Urban Planning and Development during the fall 1993, at the University of Illinois, in Chicago, and in Computer Information Systems in the winter of 1993, at the College of DuPage, in Glen Ellyn.

Michael V. Miller, James J. Miner, and **Nancy L. Rorick** participated in a workshop on "Post Flood Recovery and the Restoration of Mississippi Basin Floodplain Including Riparian Habitat and Wetlands," sponsored by the Association of State Wetland Managers and the Association of State Floodplain Managers, September 28-29, 1993, in St. Louis, MO. Miller also completed the following short courses: "Technical Release-20 Hydrological Modeling," Department of Agricultural Engineering, University of Illinois, August 12-13, 1993, in Urbana; "Modeling Unsteady Flow through a Full Network of Open Channels: The UNET Program," October 25-29, 1993, and "HEC 2 DSS and WISPRO (surface water modeling techniques), February 13-19, 1994, both at the University of Wisconsin in Madison.

James J. Miner and **Nancy L. Rorick** attended a course in Standards Technology Training in Ground Water Monitoring and Sampling Technology, sponsored by American Standards Testing Materials, October 25-26, 1993, in Chicago.

Duane M. Moore gave a lecture on the Effect of Clay Minerals in Hydrocarbon Exploration and Exploitation to the Indonesian Association of Geologists and the Indonesian Ministry of Oil and Gas, June 28-July 2, 1993. He attended the Computer Applications Workshop preceding the annual meeting of the Clay Mineral Society, September 25-30, 1993, in San Diego, CA.

Michael A. Phillips participated in a workshop on the Introduction to the New Underground Storage Tank Removal Law, presented by the Illinois office of the State Fire Marshall and the Illinois Environmental Protection Agency, November 8, 1993, in Mt. Vernon and the Annual Quality Day Conference, Argonne National Laboratory, April 7, 1994, in Argonne.

Philip C. Reed attended the Illinois Department of Public Health and the Illinois Association of Groundwater Professional's Training Program, held September 30, 1993, in Byron.

Richard J. Rice participated in a seminar on the Underground Tank Bill (HB300), November 16, 1993, in Mt. Vernon; and a workshop on Wellhead Protection and Groundwater Management Techniques in Illinois, sponsored by the U.S. and Illinois Environmental Protection Agencies, November 17-18, 1993, in Peoria.

Nancy L. Rorick participated in a workshop on identifying hydric soils, sponsored by the Soil Conservation Service, April 5 1994, in Hillsboro and completed a graduate course in wetlands through the Geology Department at Southern Illinois University, Carbondale, spring 1994.

Massoud Rostam-Abadi attended the 1993 Sulfur Dioxide Control Symposium, sponsored by the Electric Power Research Institute and the U.S. Environmental Protection Agency, August 24-27, 1993, in Boston, MA.

Michael L. Sargent participated in the following workshops: "The interpretation of reflection seismic data," jointly sponsored by the Illinois Geological Society, the Indiana-Kentucky Geological Society and the Illinois Oil and Gas Association, March 19, 1994, in Evansville, IN, and "The interpretation of seismic sections in the Rough Creek

Graben area, southeastern Illinois, southern Indiana, and western Kentucky," June 16-17, 1994, in Denver, CO.

Edward C. Smith completed Geology 185, "Spatial Analysis," during fall 1993, at the University of Illinois, in Urbana.

Lisa R. Smith presented "GIS Activities at the Illinois State Geological Survey" at the U.S. Department of Agriculture's Soil Conservation Service Soil Scientist Workshop, January 12-14, 1994, in Urbana.

Christopher J. Stohr was an instructor at the Photointerpretation/Photogrammetry Refresher Workshop at the Illinois State Water Survey, July 22, 1993, in Champaign. He completed graduate-level course work in Pedology, Field Pedology and Geographic Information Systems at the University of Illinois, 1993-1994, in Urbana.

Gail D. Taylor presented a GIS short course pertaining to the application of the GIS technology to issues relating to natural resource issues at a MID-America GIS Symposium, May 1994, in Kansas City, KA.

Paul D. Terpstra completed a one-week course in Advanced ARC/INFO, sponsored by the Environmental Systems Research Institute, January 31-February 4, 1994, in St. Charles, MO.

C. Brian Trask attended an eight-hour refresher course for waste site personnel at the University of Illinois, December 6, 1993, in Urbana.

C. Pius Weibel completed a short course in Mining Hydrogeology at the 101st annual meeting of the Illinois Mining Institute, September 23-24, 1993, in Collinsville.

Jianzhong Xu continued his thesis study in the fall 1993 and spring 1994 terms in the Department of Geology and completed Data Structure and a Software Laboratory during the fall 1993 and Computer Architecture, spring 1994, in the Department of Computer Science, University of Illinois, in Urbana.

Timothy C. Young completed a short course in "Borehole Geophysics for Environmental and Engineering Investigations," sponsored by Colog, Inc., August 30-September 2, 1993, in Golden, CO.

Participation in Scientific Conferences and Field Trips

Richard C. Berg was a co-leader of and presented information on the stratigraphy of the Boston Harbor Islands for the Geological Society of America's pre-meeting field trip, October 24, 1993, in Boston, MA.

Robert A. Bauer and **Timothy H. Larson** participated in a field trip entitled "Neotectonics of the Wabash Valley, October 9, 1993, led by the Indiana Geological Survey on its paleoliquefaction and seismic zonation work in the area of Bloomington, IN.

Ross D. Brower and **Philip C. Reed** prepared displays showcasing the Survey's groundwater research and service for the Midwest Groundwater Conference and the Illinois Groundwater Association meetings, October 6-8, 1993, in Champaign; the Illinois Specialty Growers Show, January 9-11, 1994, in St. Charles, and the annual meeting of the Illinois Water Well Association, March 21-22, 1994, in Bloomington.

Richard A. Cahill participated in the field trip on the Columbia River Estuary during the 15th annual meeting of the Society of Wetland Scientist, May 30-June 3, 1994, in Portland OR.

Mei-In Melissa Chou, Richard A. Cahill, Dennis D. Coleman and **Anthony A. Lizzio** participated in the 211th National Meeting of the American Chemical Society, August 22-26, 1993, in Chicago. Chou also participated in the Fifth International Conference on Processing and Utilization of High Sulfur Coals, October 25-28, 1993, in Lexington, KY, and the American Chemical Society's meeting, March 13-17, 1993, in San Diego, CA.

Sheng-Fu Joseph Chou, William S. Dey, Gary B. Dreher, Ivan G. Krapac, Edward Mehnert and **C. Pius Weibel** participated in the Fourth Annual Conference of the Illinois Groundwater Consortium, held March 23-24, 1994, in Makanda.

Michael J. Chrzastowski participated in a field trip along the coastal zone of Belgium and The Netherlands hosted by the International Quaternary Association's Subcommission on Northwest European Shorelines, September 20-24, 1993 and in the 19th Annual Statewide Conference of the Illinois Environmental Council, October 16, 1993, in Springfield. Chrzastowski, **Wayne T. Frankie, Dennis R. Kolata** and **Chao-li Liu** participated in the annual meeting of the Geological Society of America, October 25-27, 1993, in Boston MA.

Dennis D. Coleman and **Chao-li Liu** participated in the Pittsburgh Analytical Conference, February 28-March 2, 1994, in Chicago. Coleman also attended the Solid Waste Association of North America's 13th Annual Landfill Gas Symposium, March 22-24, 1994, in Long Beach, CA, at which he took a field trip to the Olinda Landfill Gas-to-Energy Project, March 21, in Brea, CA. Coleman, **Christine S. Fucciolo, Keith C. Hackley, Timothy H. Larson, E. Donald McKay, Melisa M. McLean, Edward Mehnert, Michael V. Miller, James J. Miner, Mary J. Mushrush, Samuel V. Panno, Matthew H. Riggs, Edward C. Smith, C. Pius Weibel** and **Timothy C. Young** participated in the 38th Annual Midwest Groundwater Conference, October 6-8, 1993, in Champaign.

Joan E. Crockett helped with the Survey's information booth at the annual meeting of the Illinois Oil and Gas Association, March 2-3, 1994, in Evansville, IN. Also attending this meeting were **Bryan G. Huff, Janis D. Treworgy** and **Emmanuel O. Udegbunam.**

Heinz H. Damberger, Keith C. Hackley, John M. Lytle and **Donald F. Oltz** participated in the Illinois Clean Coal Institute's 11th Annual Contractors' Technical Meeting, August 3-5, 1993, in Urbana. Damberger was in charge of the Illinois Mining Institute's annual meeting, attended by some 800 persons, September 23-24, 1993, in Collinsville. He participated in a field trip of the carboniferous geology of the anthracite fields of eastern Pennsylvania and New England, sponsored by the Geological Society of America's Coal Geology Division, October 21-24, 1993. Damberger also organized the program for the Coal Advisory Committee's annual meeting, May 16, 1994, in Champaign, which was attended by **Gwen L. Donnals, Anthony A. Lizzio, Donald F. Oltz** and **Colin G. Treworgy.**

William S. Dey participated in the International Joint Meeting of the American Society of Agricultural Engineers and the American Society of Civil Engineers, June 20-23, 1994, in Kansas City, MO.

Gary B. Dreher participated in the 10th International Pittsburgh Coal Conference, September 20-24, 1993, in Pittsburgh, PA.

Leon R. Follmer and **Lisa R. Smith** organized and hosted the 1993 Paleopedology Symposium, August 8-13, 1993, in Monticello. He presented several lectures on paleosol research and organized working groups to address specific issues at the symposium. He also organized a paleopedology field excursion from Illinois to Nebraska, August 13-20, 1993. Follmer participated in the annual meeting of the Soil Conservation Service, September 9, 1993, in Springfield. In addition, he participated in the Midwest Friends of the Pleistocene's field trip, May 21-23, 1994, to Door County, WI.

John P. Grube attended the annual meeting of the Illinois Oil Producers Association, September 16, 1993, in Mt. Vernon. Grube and **Donald F. Oltz** also participated in the annual meeting of the American Association of Petroleum Geologists, June 12-15, 1994, in Denver, CO. Grube, **Bryan G. Huff, Zakaria Lasemi, Rodney D. Norby**, and **Janis D. Treworgy** presented a field trip, "Waulsortian Mounds and Reservoir Potential of the Ullin Limestone ('Warsaw') in Southern Illinois and Adjacent Areas in Kentucky," sponsored by the Illinois Geological Society, April 19, 1994.

Keith C. Hackley, Ardith K. Hansel, Michael L. Sargent and **C. Brian Trask** participated in the meeting of the North-Central Section of the Geological Society of America, April 28-29, 1994, in Kalamazoo, MI, and Trask took the field trip of the Great Lakes coastal geology and coastal engineering, southeastern Lake Michigan in conjunction with the meeting. Hackley also participated in the Pittsburgh Conference 1994, held March 27-April 4, in Chicago.

Ardith K. Hansel participated in a field trip on "The Late Glacial Marine Invasion of Coastal Central New England (Northeastern Massachusetts-Southwestern Maine): Its Ups and Downs" held October 22-24, 1993, in Freeport, ME, prior to the annual meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA. She attended a post-meeting field trip covering "Glacial Geology of the Grand Valley, Michigan," April 30, 1994, in Kalamazoo, MI, following the annual meeting of the North-Central Section of the Geological Society of America and took a Midwest Friends of the Pleistocene field trip, "Quaternary Sediment Sequences in the Miami Lobe and Environs," May 14-15, 1994, in Miami, OH. In addition, she participated in the biennial meeting of the American Quaternary Association, June 19-22, 1994, in Minneapolis, MN, and attended a pre-meeting field trip on the "Development of the Mississippi and Minnesota River Valleys," June 19.

Beverly L. Herzog participated in the annual meeting of the Illinois Groundwater Consortium, March 20-21, 1994, at Makanda, as a member of the executive committee and conducted the wrap-up session. She also participated in the National Ground Water Association's Outdoor Action Conference, May 20-25, 1994, in Minneapolis, MN. As a member of the Groundwater Professional Certification Subcommittee, she reviewed applications for certification.

Bryan G. Huff participated in the annual meeting of the Interstate Oil and Gas Compact Committee, June 26-28, 1994, in Breckenridge, CO.

Myrna M. Killey participated in the annual meeting of the American Institute of Professional Geologists, October 12-16, 1993, in Springfield, MA, and attended the field trip to Northfield Mountain Pumped Storage Complex held in conjunction with the meeting. She also participated in the fall meeting of the Illinois-Indiana Section of the American Institute of Professional Geologists, September 29, 1993, in Oak Brook.

Dennis R. Kolata participated in the American Association of Petroleum Geologists Hedberg Research Conference on Basement and Basins of Eastern North America, November 11-13, 1993.

Ivan G. Krapac and **Samuel V. Panno** conducted a field trip to the ISGS' compacted soil liner for the Midwest Groundwater Conference, October 6-8, 1993, in Champaign.

Robert J. Krumm participated in the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

David R. Larson moderated a session on Wetlands Hydrology at the 38th Annual Midwest Groundwater Conference, October 7-8, 1993, in Champaign. Larson, **Edward Mehnert, Richard J. Rice, William R. Roy, Edward C. Smith** and **Timothy C. Young** participated in the spring meeting of the Illinois Groundwater Association, March 31, 1994, in St. Charles.

Zakaria Lasemi participated in the annual meeting of the Society for Sedimentary Geology that focused on the "Stratigraphic Record of Global Change," August 8-12, 1993, at Penn State University, State College, PA. He also attended a field trip on "The Classic Silurian Reefs of the Chicago Area," sponsored by the North-Central Section of the Geological Society of America, April 1, 1994, in Chicago.

Alison B. Lecouris provided demonstrations of QuEStoR at the Survey's booth at the annual meeting of the Illinois Oil and Gas Association, March 3-4, 1994, Evansville, IN.

John M. Masters participated in a joint meeting of the Indiana Geological Survey and the Indiana Mineral Aggregates Association on using limestone to capture sulfur dioxide, October 14, 1993, in Indianapolis, IN, and the annual meeting of the Illinois Association of Aggregate Producers, May 3 and 4, 1994, in Springfield.

E. Donald McKay participated in meetings of the Illinois Basin Consortium, September 27, 1993, and May 23, 1994, in New Harmony, IN.

Edward Mehnert attended the 1st International Conference on Diffuse Pollution, sponsored by the International Association on Water Quality, September 23, 1993, in Chicago, and the Illinois Agricultural Pesticides Conference, January 6, 1994, in Champaign.

James J. Miner attended the 15th annual meeting of the Society of Wetlands Scientists, May 30-June 3, 1994, in Portland, OR, and an associated field trip, June 1, of the "Columbia River Estuary by Land."

Duane M. Moore participated in the Symposium on Economic Resources of the Lower Pennsylvanian of the Illinois Basin, sponsored by the Indiana Geological Survey, November 10-11, 1993, in Bloomington, IN; and a Conference on Land Degradation, sponsored by the University of Illinois, March 26, 1994, in Urbana.

Donald F. Oltz participated in the Eastern Section meeting of the American Association of Petroleum Geologists, September 20, 1993, in Williamsburg, VA; a meeting of the Independent Petroleum Association of America, November 6-7, 1993, in New Orleans, LA; the 21st Annual Illinois Energy Conference, November 22-23, 1993, in Chicago; and the Interstate Oil and Gas Compact Commission's meeting December 4-7, 1993, in Santa Fe, NM. Oltz participated in the Illinois Mining Institute, September 23-24, 1993, in Collinsville. Oltz and **Michael L. Sargent** also participated in the Illinois Geological Society's field trip to Silurian reefs in northern Indiana, April 16-17, 1994.

James B. Risatti co-chaired the Geochemistry III: Biogeochemistry Session at the annual meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA and attended the annual meeting of the Geochemical Society held at that time.

Rodney R. Ruch participated in the Second International Conference on Managing Air Pollutants, July 1993, in Washington, D.C.

Michael L. Sargent, Beverly Seyler and **C. Pius Weibel** attended the field trip, "Waulsortian Mounds and Reservoir Potential of the Ullin Limestone ('Warsaw') in Southern Illinois and Adjacent Areas in Kentucky," sponsored by the Illinois Geological Society, April 19, 1994.

Paul D. Terpstra attended the Environmental Systems Research Institute's 14th Annual User Conference, May 23-27, 1994, in Palm Springs, CA.

C. Pius Weibel lectured during stops, October 2, 1993, in a field trip, sponsored by the Geology Club of Illinois State University, to the LaSalle-Peru area.

Lectures/Classes/Seminars Taught/Advising Graduate Students

Robert A. Bauer presented a talk, March 15, 1994, on earthquakes in the Midwest to a Civil Engineering Class on Landfill Design at the University of Illinois, Urbana.

Richard C. Berg presented a lecture on aquifer mapping for Civil Engineering 357, September 23, 1993, and a lecture on contamination potential mapping for Geology 355, September 29, 1993, at the University of Illinois, Urbana.

Ross D. Brower provided general information to several graduate students seeking groundwater and geologic information for thesis projects and demonstrated field procedures and the use of the Survey's equipment, which was made available for a thesis project in Georgia.

Richard A. Cahill served on the Master's Committee, reviewed the thesis and participated in the oral defense of a graduate student in the Department of Landscape Architecture at the University of Illinois, Urbana.

Mei-In Melissa Chou served on the Master's Dissertation Committee of a graduate student in the Department of Chemistry, Western Kentucky University.

Chen-Lin Chou gave two seminars: "Determination of trace elements in coal minerals by Synchrotron X-ray fluorescence microprobe technique," November 17, 1993, at the National Taiwan University in Taipei and "Geochemistry and sedimentary environment of black shales," March 3, 1994, at the Institute of Oceanography, located at National Taiwan University. During April 4-18, 1994, he conducted a lecture tour in China on the topics of geochemistry of Illinois Basin coals, black shales, and Synchrotron X-ray microprobe analysis of coal minerals at the Chinese Academy of Sciences' Guangzhou Institute of New Geologic Techniques, Guiyang Institute of Geochemistry, Beijing Institute of Geology, Beijing Institute of High Energy Physics, China University of Geosciences at Beijing, Sun Yat-sen University in Guangzhou, and the Institute of Mineral Deposits Geology in Guilin. Chou was a member of the Thesis Committee of an M.S. candidate in the Department of Chemistry, Western Kentucky University, Bowling Green, KY. While at the National Central University, he was a member of the Thesis Committee of an M.S. candidate at the Institute of Applied Geology.

Michael J. Chrzastowski presented geologic impacts of the 1993 flooding in Illinois, November 5, 1993, at the Department of Geology's weekly colloquium, University of Illinois, Urbana, and March 3, 1994, at the Department of Geology's weekly colloquium at the University of Illinois, Chicago. He also presented coastal geography of Illinois at a seminar, November 16, 1993, for the Department of Geography, DePaul University, Chicago.

Joan E. Crockett provided assistance in developing a data base on Ordovician oil samples from Illinois to a Ph.D. candidate at Indiana University.

Heinz H. Damberger met several times with a graduate student in the Department of Geology at the University of Illinois, Urbana, to provide background on coal mining and help set up sampling of groundwater from observation holes around underground and surface coal mines.

B. Brandon Curry presented talks on the paleolimnology and paleoclimate of south-central Illinois at the Illinois State Museum, in Springfield, on October 21, 1993, and at the Department of Geology, University of Iowa, February 24, 1994.

Philip J. DeMaris provided informal thesis advice on bedrock geology to three master's candidates at Northern Illinois University, DeKalb. He also commented on segments of their text and graphics.

Leon R. Follmer is a member of the Graduate Faculty at the University of Illinois, Urbana, serving as Adjunct Associate Professor of Geography and Geology and collaborator with the Department of Agriculture. He is also an adjunct member of the geology faculty for the Graduate Student Examination Committee at Southern Illinois University, Carbondale. Follmer lectured students in Geography 351 at the University of Illinois, Urbana, November 30, 1993, on research methods in physical geography. He also presented a lecture on loess research and co-organized a half-day workshop on loess studies, January 20, 1994, for the Geology Department, Indiana University-Purdue University at Indianapolis, IN. Follmer has formal links to 10 graduate students (seven of whom are Ph.D. candidates and three, master's candidates) at the University of Illinois, Urbana, either providing assistance and instruction on scientific and applied issues or directing research toward Illinois' need for basic geologic information. In most cases, he serves on the departmental Examination Committee.

Keith C. Hackley presented a lecture on "Recent applications of environmental isotopes to landfill situations" to a class in Hydrogeology, G-355, in the Department of Geology at the University of Illinois (U of I), Urbana. He has also given informal advice to graduate students in the Geology Department at the U of I concerning the evaluation of geochemical data collected from groundwater in Illinois and isotopic geochemical modeling of dissolved inorganic carbon within freshwater lakes.

Ardith K. Hansel is supervising research and field study and participating in and helping lead an individualized reading seminar of a Ph.D. candidate in the Department of Geology at the University of Illinois, Urbana. She has also spent three days in the field in northeastern Illinois with graduate students from Oregon State University.
Manoutchehr Heidari taught the CE 357 course in Groundwater Hydraulics for the Department of Civil Engineering at the University of Illinois, Urbana. He is a member of the Ph.D. Thesis Committee of **Edward Mehnert**.

Beverly L. Herzog gave a lecture on slug-test analysis to Heidari's CE 357 class in Groundwater Hydraulics at the University of Illinois, October 12, 1993, in Urbana and

a seminar on "Hydrogeologic Investigation of Eastern Tazewell and Western McLean Counties" at Illinois State University, November 4, 1993, in Normal.

Randall E. Hughes consulted with eight graduate students in the Geology Department; one, in the Archeology Department, and one, in the Soil Sciences Department at the University of Illinois, Urbana, and one from Queens College, New York City, NY, who worked on the Illinois Basin. For three, he provided detailed recommendations on ways to solve problems. In those cases, he ran analyses for them and helped evaluate their results. Hughes also met regularly with students and faculty from the University of Illinois in the local discussion group on clay minerals.

Myrna M. Killey taught Introduction to Geology, ESC 102, September-December 1993, at Parkland College, Champaign and gave a lecture on "Glacial Geology of Northeastern Illinois" and Women in Geology to the Earth Science for Teachers class, SCE 511, October 25, 1993, at National-Louis University in Wheaton.

Dennis R. Kolata is advising five Ph.D. candidates, three of whom are in the Department of Geology at the University of Illinois, Urbana; one, in the Geology Department at Queens College, New York City, NY, and one, in the Geology Department at the University of Cincinnati.

Ivan G. Krapac taught a half-day seminar on the construction and monitoring techniques for soil liners February 19, 1994, to the Civil Engineering class, CE 398, at the University of Illinois, Urbana.

Timothy H. Larson lectured to the Groundwater Hydraulics class, CE 357, on geophysical exploration methods, November 9, 1993, at the University of Illinois, Urbana.

Chao-li Liu provided an introduction to radiocarbon dating and gave a laboratory tour January 11, 1994, to Prof. Stanley Ambrose's class from the Department of Anthropology, the University of Illinois (U of I), Urbana. He also provided advice to three Ph.D. candidates from the U of I, Urbana--two from the Department of Geology and one, from the Department of Anthropology.

Anthony A. Lizzio presented seminars on the production and potential applications of carbon molecular sieve materials in gas separation processes, October 18, 1993, at the Department of Materials Science and Engineering at the University of Illinois (U of I), Urbana; November 4-5, 1993, at Amoco Research Center, Naperville; November 11-12, 1993, at Allied Signal, Des Plaines; November 18-20, 1993, at Oak Ridge National Laboratory, Oak Ridge, TN; November 22-23, 1993, at Southern Illinois University, Carbondale. He also advised four Ph.D. candidates, including **Mehrdad Lordgooie**, and an M.S. candidate **Joseph A. DeBarr** at the U of I, Urbana, on their thesis work.

John M. Masters assisted one graduate student in geology with identifications of heavy minerals for his thesis.

E. Donald McKay served on the Thesis Committees of **Lisa R. Smith**, M.S. candidate in the Department of Geography, University of Illinois (U of I), Urbana, and **Barbara J. Stiff**, who received her M.S. in Geography from the U of I.

Michael V. Miller gave a seminar on "Wetland Mitigation and Current ISGS Activities in Wetland Research " November 19, 1993, in the Geography Department's Colloquium Series at the University of Illinois, Urbana.

Duane M. Moore lectured a class in Environmental Science at Illinois Valley Community College of LaSalle-Peru on the principals of groundwater and its relationship to human habitation. He serves on the Thesis and Ph.D. committees and is directing the major part of the work of a student in the Department of Geology at the University of Illinois, Urbana.

Donald F. Oltz served on **Hannes E. Leetaru's** Ph.D. Preliminary Examination Committee and provided guidance on his thesis topic in the Geology Department at the University of Illinois. He also worked with an advisor in the same department on delimiting the thesis topic and other issues for **Jianzhong Xu.**

Samuel V. Panno presented a lecture, "The effects of gamma radiation on brine chemistry: Implications for disposal of high-level nuclear waste in a salt repository," March 30, 1994, to a graduate class in the Department of Nuclear Engineering, University of Illinois, in Urbana. He is also assisting a Ph.D. candidate in the Department of Nuclear Engineering, University of Illinois, with her dissertation.

Michael A. Phillips taught Astronomy 111 during the fall 1993 and Geology 213 during the spring 1994 term at Shawnee Community College.

James B. Risatti is a member of the Dissertation Committee of two students in the Department of Civil Engineering, Northwestern University, Evanston; a co-adviser and member of the Dissertation Committee of a student in the Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, IN, and a member of the Dissertation Committee of PH.D. candidate **Gary L. Salmon**, Department of Chemistry and Biochemistry, Southern Illinois University, Carbondale.

Massoud Rostam-Abadi is a member of the Ph.D. faculty committees of **Mehrdad Lordgooei** and two others in the Environmental Engineering Division, Department of Civil Engineering, University of Illinois, Urbana.

William R. Roy is a member of a Doctoral Committee and a Thesis Committee, respectively, for two graduate students in the Department of Agronomy, University of Illinois, Urbana.

Gary L. Salmon presented a seminar on "Environmental Applications of Pyrolysis-Gas Chromatography/Mass Spectrometry" January 31, 1994, in the Department of Chemistry, Southern Illinois University, Carbondale. He was co-director of the Research Committee of three graduate students, two of whom are Ph.D. candidates, in the Department of Geology at Southern Illinois University, Carbondale.

Michael L. Sargent lectured a class on the geology of Illinois, geology maps and the geology of the Grand Canyon of the Colorado River in December 1993 at Parkland College, Champaign. He also had lengthy discussions with four graduate students enrolled in studies at Queens College, New York City, NY; Northeastern Illinois University, Chicago; DePaul University, Chicago, and the University of Illinois, Urbana. **Lisa R. Smith** has assisted two graduate students in the Planning Department and one in the Forestry Department at the University of Illinois, Urbana, during 1993-1994, providing data, assisting in building data bases and advising them regarding the GIS and ARC/INFO.

Christopher J. Stohr lectured at the University of Illinois on "Global Positioning Systems for Wetland Monitoring" at the Agronomy seminar, fall 1993; "Investigations at a Hazardous Waste Site," at the Agronomy Seminar, spring 1994; "Use of Geosyn-

thetics in Landfill Design," for Civil Engineering 498--Geosynthetics, spring 1994, and "Investigations of a Hazardous Waste Landfill and Current Research on Closed Landfills Using Remote Sensing, Field and Laboratory Methods," for Civil Engineering 399--GeoEnvironmental Engineering, spring 1994.

Wen-June Su presented the following lectures: "Engineering Geology Aspects of Soil Liners and a Full-Scale Earthen Liner Project at the Illinois State Geological Survey," June 14, 1994, at the Resource Technology Division, Industrial Technology Research Institute in Hsin-Chu, Taiwan; "Study of Earthquake-Induced Landslides at the Illinois State Geological Survey," June 15, 1994, at the Chinese Central Geological Survey in Taipei, Taiwan; "Highlights of Engineering Geology Studies at the Illinois State Geological Survey," June 21, 1994, at the Department of Applied Geology, National Central University in Chung-Li, Taiwan; and "Study of Paleo-Liquefaction Features in Illinois and Its Implication for the Regional Seismic Assessment," June 24, 1994, at the Department of Geology, National Taiwan University in Taipei, Taiwan.

Janis D. Treworgy lectured on "Tectonic subsidence of the Illinois Basin," November 24, 1993, at a seminar in the Geology Department, University of Iowa, in Iowa City, IA.

Robert C. Vaiden was an instructor of the course "Introduction to Geology" for the fall 1993 and spring 1994 terms at Parkland College, Champaign.

Offices/Committee Memberships/Services for Professional/Educational Societies

Robert A. Bauer has served in several capacities with the Association of Engineering Geologists--as Rock Mechanics Chairman of the North Central Section, Chairman of the National Rock Mechanics Committee, and liaison between Rock Mechanics and Subsidence committees of the National Subsidence Committee. He also reviewed several papers for the U.S. Bureau of Mines.

Richard C. Berg served as Chairman of the Quaternary Studies paper session at the national meeting of the Geological Society of America, October 25-28, 1993, in Boston, MA.

Richard A. Cahill is a member of the University of Illinois' Radiation Hazards Committee and the Survey's representative to the local chapter of Sigma Xi. He provided technical review to the U.S. Army Corps of Engineers, Chicago District, of the North Branch of the Chicago River: A Literature Review of the River with Emphasis on Sediment Contamination; technical review to the U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, of Lake Michigan Mass Balance/Mass Balance Work Plan, and technical review of Environmental Science and Technology for the American Chemical Society, and was a member of the Technical Review Panel for the Great Lakes Protection Fund.

Somendra Chakravorty is serving a two-year term through 1995 on the Board of Directors of the Illinois Association of Environmental Professionals.
Mei-In Melissa Chou reviewed a manuscript for the *Journal of the America Institute of Chemical Engineers*.

Michael J. Chrzastowski was a member of the North American Working Group for the International Correlation Programme (IGCP) Project 274, Coastal Evolution in the Quaternary. In this capacity, he provided contributions to the IGCP's 1993 annual report and was appointed Chief Editor for a special issue of *Marine Geology*, which will be a collection of papers from the final meeting. As the 1993 Chairman of the Coastal

and Shelf Working Group of SEPM/Society for Sedimentary Geology, he was responsible for organizing a working group's symposium held in conjunction with the October 1993 annual meeting of the Geological Society of America (GSA) in Boston, where he was elected to be the 1994 Chairman and to organize the working group's symposium for the 1994 annual meeting of GSA in Seattle, WA. Chrzastowski also was a scientific reviewer of a paper on Lake Michigan lake-level history submitted for GSA's *Bulletin*.

Heinz H. Damberger serves on the Editorial Board of the *International Journal of Coal Geology* for which he reviewed six papers. He is Secretary-Treasurer of the Illinois Mining Institute and Editor of *IMI Proceedings* for which he reviewed and edited nine papers. Damberger is also a member of the Research and Development Committee of the Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers and a member of the Board of Directors of the newly founded National Museum of Coal Mining to be located in West Frankfort. In addition, he has reviewed and helped revise the latest *Coal Facts* for the Illinois Coal Association; worked on a book, Pictorial History of Coal Mining in Illinois, with Chris Ledvina, assisting in the selection of photographs and providing charts and figures; reviewed the Geological Society of America's *Special Paper 267: Cretaceous coal deposits of the world*, containing 23 papers, and revised an article on Illinois' Coal in the Keystone Coal Industry Manual.

Gary B. Dreher reviewed a proposal for the Water Resources Center at the University of Illinois, Urbana; two manuscripts for the *Journal of Environmental Quality*, and two chapters for the English version of a Turkish book on coal.

Paul B. DuMontelle was nominated by the Association of Engineering Geologists as its Secretary for the coming year.

Leon R. Follmer serves as President of the North American Loess Working Group and Secretary-Treasurer of the Paleopedology Commission of the International Union for Quaternary Research and Co-chairman of the Illinois Quaternary Association. Follmer is a member of the Editorial Board of *Catena* and the *International Journal of Soil Science, Hydrology and Geomorphology*, the International Editorial Advisory Board of the *Journal of Quaternary Science*, and the U.S. National Committee of the International Quaternary Association, established by the U.S. National Academy of Science through the National Research Council.

Joyce K. Frost reviewed a proposal for the Research Board at the University of Illinois, Urbana.

Ardith K. Hansel is a panel member for two years through 1995 for the Quaternary Geology and Geomorphology Division of the Geological Society of America and a member-at-large on the Management Board of the North-Central Section of the Geological Society of America from 1994-1997. She has served as a corresponding committee member to the Subglacial Processes and Sediments Work Group of the International Quaternary Association's Commission on Formation and Properties of Glacial Deposits since 1987 and as a corresponding committee member to the International Quaternary Association's Subcommission on North American Stratigraphy since 1988. She has also been a technical review panel member of the Great Lakes Protection Fund since 1991.

Beverly L. Herzog has been appointed to a three-year term on the Certified Groundwater Professional Subcommittee of the Education Committee of the National Groundwater Association and was reappointed to the Editorial Board of the journal *Groundwater Monitoring and Remediation* for the sixth year. In addition, she serves on the Editorial Board of *Ground Water Monitoring Review* of the Association of Ground

Water Scientists and Engineers (AGWSE). In this capacity, Herzog reviewed six papers this reporting period. She has also served on the Publications Committee of AGWSE. Herzog served as Secretary in 1993 for the Illinois-Indiana Section of the American Institute of Professional Geologists. As 1993 Chairman of the Illinois Groundwater Association, she organized the semi-annual meetings. She reviewed approximately 120 proposed standards for the American Society for Testing Materials as a member of the D-18.21 Subcommittee on Groundwater Monitoring. Herzog also reviewed a paper for the *Journal of Environmental Engineering* and a paper for the *Water Resources Bulletin.*

Bryan G. Huff is President of the Illinois Geological Society for 1993-1994 and a member of the American Association of Petroleum Geologists' House of Delegates.

Randall E. Hughes continues as Managing Editor for the *Journal of Applied Clay Science.*

Myrna M. Killey is Treasurer of the American Institute of Professional Geologists (AIPG) for 1993-1994; Newsletter Editor and member of the Executive Committee for the Illinois-Indiana Section of AIPG, positions she has held since 1990; and liaison for AIPG to the North-Central Section of the Association of Engineering Geologists, a position held since 1986.

Dennis R. Kolata reviewed two manuscripts for the *Journal of Paleontology,* four manuscripts for the Geological Society of America, five proposals for the National Science Foundation, and two proposals for the American Chemical Society.

David R. Larson was elected to the Board of Directors of the Illinois Groundwater Association for 1993-1994.

Timothy H. Larson is Co-Chairman of the Public Affairs Committee for the Engineering and Environmental Geophysics Society for two years through September 1994.

Hannes E. Leetaru is a member of the Computer Applications Committee for the Society for Sedimentary Geology for three years through June 1997.

Anthony A. Lizzio reviewed a manuscript for the American Institute of Chemical Engineer's *Journal.*

John M. Lytle is a member of the Program Committee of the Illinois Clean Coal Institute and the Technical Advisory Committee for Coal Combustion Residue Management (CCRM). As a peer reviewer, he reviewed one paper for the *Journal of Fuel Processing Technology,* five proposals for the U.S. Department of Energy's Small Business and Innovative Research Program, and 12 proposals for the CCRM's program. Lytle also reviewed Southern Illinois University at Carbondale's Coal Extraction and Utilization Center's operations and program and prepared a 13-page report on his findings.
E. Donald McKay reviewed six proposals with GIS components for the Connecticut Yankee Ingenuity Grant Program in 1993-1994.

Edward Mehnert reviewed one manuscript for the *Water Resources Bulletin.*

Michael V. Miller is a member of the subcommittee on E50.05 Wetlands of the American Society for Testing Materials' Committee on Environmental Assessment.

Duane M. Moore is the Historian for the Clay Minerals Society and completed a term as Councilor of the Clay Minerals Society in October 1993.

Rodney D. Norby reviewed an article to be published in a Geological Society of America Special Paper.

Donald F. Oltz is a regional representative to the Petroleum Technical Transfer Board. He is also President of the Eastern Section of the American Association of Petroleum Geologists (AAPG) 1993-1994; has been reappointed to the Research Committee of AAPG, serving until 1995; is a member of the Enhanced Oil Recovery and Research committees and the Environmental Subcommittee of the Research Committee for the Interstate Oil and Gas Compact Commission; and a member of the AAPG National Resource Assessment Committee (Midwest Region). Oltz reviewed three EPSCOR research proposals for the U.S. Department of Energy.

Russel A. Peppers is a member of the Midcontinent Pennsylvanian Stratigraphic Working Group of the Society of Economic Paleontologists and Mineralogists.

James B. Risatti reviewed a journal article for *Geochimica Cosmo. Acta.* as well as three pre-proposals and two proposals for the Water Resources Office at the University of Illinois, Urbana.

Massoud Rostam-Abadi was elected Program Coordinator for the 1996 annual meeting of the American Institute of Chemical Engineers (AIChE) by the Executive Committee of the Fuel and Petrochemicals Division of the AIChE. He reviewed six papers for AIChE's *Journal, Industrial and Engineering Chemistry, Fuel Processing Technology, Thermochemica Acta,* and U.S. Department of Energy's *Small Business Innovative Research.* Rastom-Abadi also reviewed 10 papers for the 1993 AIChE's Summer Meeting.

William R. Roy is an Associate Editor and a member of the Editorial Board of the *Journal of Environmental Quality,* serving a term from 1991-1994. For the publication, he has managed 33 manuscripts and five book reviews. Roy has also reviewed three proposals for the Water Resources Center and one paper for the Department of Agronomy at the University of Illinois; two manuscripts for the *Journal of Hazardous Materials;* and two papers for the *Journal of Environmental Engineering.*

Rodney R. Ruch is Chairman and has been Secretary through June 1994 of the ISO/TC27/SC5 Subcommittee on "Solid Fuels-Methods of Analyses," a group that reviews and updates some 50 international methods used in coal contracts and involves 50 chemists from 21 countries. He organized and conducted an international meeting in Berlin, November 1993, to review and revise the methods.

Gary L. Salmon is a member of the Advisory Committee for the Urbana branch of the American Chemical Society.

Michael L. Sargent is an institutional representative to the Geological Society of America. He reviewed a paper for the U.S. Geological Survey and reviewed and edited a guide for a geological field trip of the Illinois Geological Society.

Christopher J. Stohr is Manager of the Remote Sensing Committee of the Association of Engineering Geologists; recent past Chair, Engineering, Atmospheric and Hydrospheric Applications Committee, Remote Sensing Applications Division, and recent past Illinois representative to the Western Great Lakes Region of the American Society of Photogrammetry and Remote Sensing; member of Committee D-18-0103 on Remote Sensing, Committee D-18-0105 on Geologic Mapping and Committee D-18-0106 on Investigating and Sampling Soil and Rock of the American Society for Testing and

Materials; and prepared reports of activities of the Remote Sensing Committee for the Board of the Association of Engineering Geologists.

Wen-June Su reviewed two proposals for the U.S. Geological Survey's National Earthquake Hazards Reduction Program and an article for the Association of Engineering Geologists' *Bulletin*.

C. Pius Weibel is a member, for an unrestricted term, of the Midcontinent Pennsylvanian Stratigraphic Working Group of the Society for Sedimentary Geology and a member, for an unrestricted term, and reviewer of undergraduate student grant proposals for the Earth Science Division of the Illinois State Academy of Science.

CONTRIBUTIONS TO OTHER GOVERNMENT AGENCIES

Testimony/Information Supplied to Local/State/National Agencies/Committees

Curtis Abert addressed the land-use officials of Will County, March 2, 1994, in Joliet on Quaternary geology and aquifer sensitivity of the southern half of the county to help them in selecting a site for a landfill.

Michael L. Barnhardt presented a paper, "Sediment mapping and groundwater studies in flooded areas along the Mississippi River near Rock Island, Illinois," at the Illinois Geological Mapping Advisory Committee Meeting, November 14, 1993, in Springfield. At the meeting of the advisory committee on May 5, 1994, in Urbana, he gave the paper, "Reclamation of damaged military training areas: Monitoring and mapping soil erosion."

Robert A. Bauer was among staff members of the ISGS, February 16, 1994, who helped staff members of the Illinois Department of Insurance evaluate if the citizens of the state are properly covered by insurance for earthquake damage. He also presented findings, March 27, 1994, on coal mine subsidence from room-and-pillar versus longwall mining in Illinois to the Embrass Coal Association in Oakland.

Richard C. Berg made a presentation on geologic mapping of the Champaign 1:100,000 Quadrangle, March 15, 1994, to members of the Mahomet Valley Water Authority in Clinton. He reviewed "A Guide to Preparing Natural Resource Information Reports (NRI)" for the Illinois Department of Agriculture. Five of his publications (ISGS Circulars 531, 532, 542, 546 and 549) were suggested for use by the 98 Illinois Soil and Water Conservation Districts, county boards and other local agencies to assess geology and potential for groundwater contamination as part of an NRI report, required by Illinois statute when a parcel of vacant or agricultural land is considered for some other use or zoning change. In addition, Berg consulted with the Illinois Environmental Protection Agency and many private geological/geotechnical consulting companies concerning HB 300 that became law and uses the ISGS Circular 532 to evaluate the potential for contamination from underground storage tanks.

Michael J. Chrzastowski presented findings from the 1992 and 1993 coastal monitoring at Lake Forest to representatives of the Illinois Department of Transportation's Division of Water Resources and the Chicago District Office of the U.S. Army Corps of Engineers at a meeting on September 10, 1993, in Chicago. He hosted a conference call on October 7, 1993, with representatives of the State Geological Surveys from the nine states affected by flooding of the Mississippi and Missouri rivers to develop a consortium and a cooperative research proposal. Chrzastowski also participated in a planning session, June 30, 1994, with the Chicago District of the U.S. Army Corps of Engineers, concerning 1994-1995 coastal-process studies along the shore of Lake Michigan.

Anne L. Erdmann gave a talk, May 5, 1994, on the "Geologic evaluation of the proposed new town site: Valmeyer, Illinois," at a meeting of the Illinois Geologic Mapping Advisory Committee in Champaign.

Ardith K. Hansel presented a paper on a revised lithostratigraphic framework for the deposits of the last glacial episode in Illinois at a meeting of the Illinois Mapping Advisory Committee, April 5, 1994, in Urbana.

Beverly L. Herzog presented updates on the groundwater resources study in eastern Tazewell and western McLean counties to the Long-Range Water Plan Steering Com-

mittee, September 29, 1993, in Bloomington and to the Central Region Groundwater Protection Planning Committee, May 4, 1994, in Tremont. She presented a talk on geologic criteria in landfill siting to the Macon County Landfill Siting Committee, October 15, 1993, in Decatur. Herzog presented a proposal for a potential hydrogeological study for Dewitt and Piatt counties to the Mahomet Valley Water Authority's (MVWA) Executive Committee, January 7, 1994 and attended the annual meeting of the MVWA, March 15, 1994, in Clinton, to explain the highlights of the proposal. She and **Keros Cartwright** reviewed a consultant's report on the potential impact of a proposed balefill in Cook County on a nearby fen for the U.S. Army Corps of Engineers in March 1994. The Corps will use their comments in determining whether the balefill application should be accepted or denied or to decide whether they should request additional work of the applicant. With two other staff members on February 15, 1994, Herzog discussed the use of Circular 532 in House Bill 300 on underground storage tanks as well as the role of the ISGS and how it can help the Pollution Control Board. She also gave a talk on "Groundwater Resources Evaluation of Western McLean, Eastern Tazewell Counties, Illinois," to the Illinois Geologic Mapping Advisory Committee, May 5, 1994, in Champaign.

Donald A. Keefer presented several maps illustrating leaching of pesticides to groundwater, discussed the processes used to generate the maps, their limitations and other issues of relevance to the Pesticide Subcommittee of the Interagency Coordinating Committee on Groundwater in March 1994. In addition, he helped review two draft regulations governing monitoring activities at agrichemical facilities within the setback zones of wells for public water supplies for the Illinois Environmental Council.

Robert J. Krumm and **Melissa McLean** made presentations, June 23, 1994, to members of the Carroll County Board and the Jo Daviess-Carroll Joint Action Solid Waste Planning Agency on the ISGS' geographic information system, limitations of digital data, and map scale concerns as well as the Geologic Assistance (project) for Solid Waste Disposal Facilities.

David R. Larson participated in a teleconference with various state and federal officials and consultants concerning immediate, short-, and long-term issues about the quality of groundwater, decontamination and rehabilitation of water wells, and issues of well sanitation and safety to convey to well owners and users, July 29, 1993. He also gave a slide presentation covering the hydrologic cycle, basics of aquifer hydrology, and the hydrogeologic setting of the Lake Vermilion area at a public information meeting held by Inter-State Water Company on their investigation of the groundwater resources in the area, August 24, 1993, in Bismarck.

Timothy H. Larson presented a talk on "Earthquakes in Illinois" to staff members of Ford County's Emergency Management Agency, April 28, 1994, in Stelle. He also made a presentation on proposed geophysical work near Streator to members of the Vermilion Watershed Protection Program in October 1993.

E. Donald McKay presented "GIS Applications at the ISGS" to the Illinois State Water Plan Task Force, August 5, 1993, in Champaign. He discussed pending legislation regarding the use of the GIS for land surveying with representatives of the Illinois Professional Land Surveyors Association followed by conference calls with various state agencies to discuss appropriate language in the bill. He prepared written testimony and submitted it to Illinois House Committee hearings on HB1915 to revise the Illinois Land Surveyor's Act, which sought to include the use of the GIS to locate property boundaries in the definition of the practice of land surveying. McKay wrote and presented the Survey's testimony to the Illinois General Assembly's Task Force of Geographic Information Management Technology on: State Digital Communications

Network; Statewide Digital Basemap; State Government Coordination and Applications; Local Government Coordination and Applications; Private Sector Interface, coauthored with David L. Gross, and Funding, Cost Recovery, and Public Access, coauthored with David L. Gross. He also prepared and presented a GIS demonstration to the Low-Level Radioactive Waste Task Group, April 1994, at the ISGS. McKay presented a talk on the "Prospects and Priorities for Geologic Mapping Programs in Illinois" to the Illinois Geological Mapping Advisory Committee, April 1994, in Urbana, and gave a presentation on mapping priorities for Fiscal Year 1995 to the Illinois Geologic Mapping Advisory Committee's Subcommittee on Mapping Priorities in June 1994.

Michael V. Miller presented a talk on "Map and Scale in Wetland Issues" to the Illinois Geologic Mapping Advisory Committee, May 5, 1994, in Champaign.

W. John Nelson made a presentation on the "Evidence of Tertiary Faulting in Southern Illinois" at a meeting of the Illinois Geologic Mapping Advisory Committee, October 14, 1993.

Donald F. Oltz made a presentation on the Petroleum Technical Transfer Council to the Illinois Basin Consortium, May 23, 1994, in New Harmony, IN.

Samuel V. Panno presented a talk on groundwater in karst terrains to the Interagency Coordinating Commission on Groundwater, July 10, 1993, in Springfield.

Lisa R. Smith presented "The Illinois State Geological Survey's Response to 1993 Flood" at a meeting of the Illinois Mapping Advisory Committee, October 14, 1993, in Springfield. She also provided informal testimony at the Geographic Information Management Technology Forum to the Illinois General Assembly, January 11, 1994, in Springfield. She presented the Survey's official stance on the formation of an Illinois Geographic Information Council and discussed state government's coordination in GIS efforts and the application of the GIS to state government tasks.

Barbara J. Stiff presented the Survey's flood response and interagency cooperative efforts at a meeting of the Water Resources Board, August 5, 1993 in Springfield.

Participation on Local/State/National Government Advisory Committees

Robert A. Bauer is a member of an Ad Hoc Committee on Identification of Research Needs of Abandoned Mines for the National Mine Land Reclamation Center, Midwestern Region and reviewed proposals for the program concerning "Abandoned Mine Subsidence Research Needs in the Midwest." Bauer and **Michael J. Chrzastowski** participated in Valmeyer's town meeting, December 14, 1994, concerning the zoning and development ordinances for the new town of Valmeyer.

Richard C. Berg, who was a member of U.S. Environmental Protection Agency's (USEPA) work group that developed a technical assistance document for states to use as a guide to assessing groundwater resources and evaluating aquifer sensitivity and vulnerability, reviewed final drafts of this report during the year. As a member of the USEPA's Ground Water Work Group under the U.S. Department of Agriculture's Flood Environment Committee, he helped evaluate the long-term groundwater monitoring needs and hydrogeologic investigations related to the 1993 flooding. He also participated in quarterly meetings of the Interagency Coordinating Committee on Groundwater.

Heinz H. Damberger is a member of the Steering Committee of the U.S. Department of Energy's Energy Information Administration's Coal Reserve Assessment Program

for which he reviewed the progress and final reports on coal reserve base reassessment by the Kentucky Geological Survey and the report on coal reserve assessments by the New Mexico Geological Survey. He is also on the roster of reviewers of research proposals on coal for the National Science Foundation.

Leon R. Follmer participated on the Department of Energy and Natural Resources' Task Force on Global Climate Change, July 7, August 3 and November 16, 1993, and reviewed recent studies by the Indiana Geological Survey on liquefaction dikes in Indiana.

Wayne T. Frankie is a member of the Conservation Education Advisory Board and attended its meetings, December 14, 1993, March 16, 1994, and June 17, 1994, in Springfield.

Beverly L. Herzog replaced Paul DuMontelle as the ISGS' member on the Executive Committee of the Illinois Groundwater Consortium. She is the Survey's representative at quarterly meetings of the Intergovernmental Coordinating Committee on Groundwater. Herzog represents the ISGS and the Illinois Groundwater Association in the Abandoned Well Sealing Coalition, which sponsors county demonstrations on well sealing.

Dennis R. Kolata served on the proposal review panel for the U.S. Geological Survey's National Earthquake Hazard Reduction Program, July 29-30, 1993, in Albuquerque, NM, and spent three weeks prior to the meeting reviewing 57 proposals.

Anthony A. Lizzio served on a peer review panel to assess projects funded by the U.S. Department of Energy's Fossil Energy Advanced Research Program (Panel 3: Separations Gas/Gas), January 11-15, 1994, in Washington, D.C.

E. Donald McKay was named to the Board of Directors of the Illinois GIS Association. He is Assistant to the Secretary and Meeting Program Coordinator of the Illinois Geologic Mapping Advisory Committee and a member of the Policy Subcommittee of the Champaign County GIS and Computer Network Implementation Committee. McKay serves on the Subcommittee on Digital Data Quality and Standards and the Subcommittee on Tax Assessment Mapping of the Illinois Mapping Advisory Committee.

Edward Mehnert is a member of the Pesticide Subcommittee of the Interagency Coordinating Committee on Groundwater and reviewed one research proposal for the Water Resources Center at the University of Illinois, Urbana.

Michael V. Miller is a member of the Illinois Department of Transportation's District 1 Wetlands Advisory Committee.

James B. Risatti is a member on the Interagency Work Group for the Waukegan Remedial Action Plan, coordinated by the Illinois Environmental Protection Agency.

C. Brian Trask is Chairman of the Champaign Environmental Advisory Commission and a member of the Stormwater Management Task Force, an advisory body to the City Council of Champaign.

Robert C. Vaiden is on the Advisory Committee to the Urbana Park District and Manager of the Meadowbrook Prairie restoration site.

Patricia G. Wasson was elected to a three-year term as the Special Interest Representative on the Board of Directors of the Lincoln Trail Libraries System effective July 1, 1994.

CONTRIBUTIONS TO THE PUBLIC AND INDUSTRY

Popularized Addresses/Presentations for Civic Groups/Public Meetings

Curtis Abert was interviewed about using the GIS to locate the Geographic Center of the landmass of Illinois, March 7, 1994, by the Champaign *News Gazette.*

Robert A. Bauer presented a talk, May 17, 1994, on earthquakes in the Midwest to the Springfield Rock and Mineral Club.

Richard C. Berg presented a lecture on the flood of 1993 to science students, March 2, 1994, at Urbana Middle School, Urbana.

Michael J. Chrzastowski made a presentation on the Survey's coastal studies carried out on Lake Michigan at the November 18, 1993, meeting of the Hydraulics Study Group in Champaign. He also made slide presentations about "The Great Flood of 1993" on January 13, 1994, at The Izaak Walton League's chapter meeting in Champaign and on February 22, 1994, at the "Know Your University" series at the U of I, Champaign. Chrzastowski was interviewed on April 12, 1994, by *The Chicago Tribune* for an article concerning coastal erosion near North Point Marina.

Joseph A. Devera gave a popular talk on dinosaurs to the students at the Dongola Public School, May 1994, in Dongola. He also addressed "Were there Dinosaurs in Illinois?" with the Illinois Geologic Mapping Committee in May 1994.

Anne L. Erdmann presented workshops on "Back to the Future with Ice Age Soils" at the "Expanding Your Horizons in Science and Mathematics" conference for girls in grades seven and eight, March 26, 1994, in Springfield.

Wayne T. Frankie presented exhibits and demonstrations for grade school children during events celebrating Coal Awareness Week, October 19, 1993, in Carterville and October 21, 1993, in Springfield. He presented a talk on "Energy Minerals and the Way We Live," March 10, 1994, to members of the Southern Illinois Earth Science Club in Benton.

Beverly L. Herzog was interviewed by CNN-TV in October 1993 about the flooding caused by high levels of groundwater in the Havana area. She spoke on "Hydrogeologic Investigation of Eastern Tazewell and Western McLean Counties" to the Tremont Women's Club, December 3, 1993. She spoke on the "Geologic History of Farmer City, Illinois" to the Farmer City Genealogical and Historical Society on June 23, 1994.

Russell J. Jacobson gave a presentation on the "Excavation of dinosaurs in the Morrison Formation of the NW Black Hills," February 1994, at the Illinois State Museum, Springfield.

Myrna M. Killey presented talks on "The Dynamic Earth and Plate Tectonics" to eighth grade teachers and "Geology of Great Lakes area with emphasis on glacial geology of the Chicago area" to fifth grade teachers, August 30, 1993, in Oak Park; and gave a hands-on workshop with samples of glacial materials to fifth grade teachers, February 2, 1994, in Oak Park. In addition, she staffed the "Every Day is Earth Day" exhibit at the "Expanding Your Horizons in Math and Science" conference for middle-school girls, March 26, 1994, in Springfield.

Timothy H. Larson was interviewed about earthquake hazards in Illinois, January 17, 1994, by WCIA-TV, Champaign, and also gave a talk on "Earthquakes" to elementary school students, April 28, 1994, in Urbana.

E. Donald McKay made presentations and demonstrations on the GIS and Geologic Mapping for staff at the Field Museum, members of the Illinois General Assembly, representatives from state agencies, students, and visitors.

Donald F. Oltz was interviewed by the Associated Press regarding improved oil recovery and the state of Illinois' oil industry, December 9, 1993.

Samuel V. Panno presented a talk on landfills, clay liners and groundwater hydrology and geochemistry to a grassroots group (C.A.R.E.) against the expansion of a local landfill, September 30, 1993, in Hoopeston.

Michael A. Phillips presented a talk on "Geology" at Marion High School's Career Day, April 21, 1994, in Marion.

Matthew H. Riggs gave two talks on "Dinosaurs and Fossils" at the First United Methodist Preschool and Next Generation Day Care, April 13, 1994, in Urbana.

James B. Risatti presented a talk, "Volo Bog: A 22-Year Affair," at the Volo Bog Nature Center, January 30, 1994.

Nancy L. Rorick conducted a session on water quality entitled "Where shall we put the well?" at an "Expanding Your Horizons" workshop for seventh and eighth grade girls at Carbondale.

William R. Roy gave four lectures on basic earth science, earthquakes and environmental science to students at Yankee Ridge School in Urbana.

Michael L. Sargent presented "A Geologic Adventure through the Grand Canyon of the Colorado River," as a visiting lecturer at the William Starkle Planetarium, Parkland College, November 1993, in Champaign.

Edward C. Smith made a presentation on the geology, groundwater resources and well construction in Scott County, during Groundwater Protection Day, June 23, 1994, in Winchester. He also was interviewed regarding groundwater flooding in the Havana region of Illinois by the *Pekin Times*, Pekin.

Lisa R. Smith was interviewed for and mentioned in the article, "What's under Central Illinois," which appeared in the *News Gazette* newspaper, July 8, 1993, in Urbana.

Barbara J. Stiff presented "Hire the Future at the Illinois State Geological Survey" at a Hire the Future Banquet, July 19, 1993, in Urbana.

Robert C. Vaiden gave a basic lesson in geology to the third grade class at Prairie School, October 1993, in Urbana; worked with children on geologic history and fossils at the Urbana Park District's "Dinosaur Days," May 8, 1994; gave a talk on groundwater and related geology to local landowners at a well-sealing demonstration, June 21, 1994, in Menard County, and conducted a hands-on demonstration of glacial geology for elementary, middle and high school teachers at a workshop sponsored by the State Board of Education at Northern Illinois University's Laredo Taft campus, June 29, 1994.

Jianzhong Xu gave a thin-section demonstration and a minerals show at Bottenfield School, April 18, 1994, in Champaign.

OTHER SERVICES TO THE PUBLIC

Wayne T. Frankie and **Edward C. Smith** served as judges for the Regional Science Fair, March 26, 1994, at Parkland College, Champaign.

John M. Masters served as Judging Chairman of the Earth Science Division of the Illinois Junior Academy of Science for 1993-1994, which was held May 7, 1994, in Champaign. Judges from the ISGS were **Philip J. DeMaris, Anne L. Erdmann, Jonathan H. Goodwin, Randall E. Hughes, Russell J. Jacobson, Myrna M. Killey, Philip C. Reed and Timothy C. Young.**

Illinois Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION

Appendix B
PUBLICATIONS

July 1993 to June 1994

ILLINOIS STATE GEOLOGICAL SURVEY SERIES

(Released to the public from July 1, 1993, to June 30, 1994)

Circulars

551 *Coal Resources of the Dekoven and Davis Members (Carbondale Formation) in Gallatin and Saline Counties, Southeastern Illinois.* 1993. **Jacobson, R.J.** 41 p., 9 figures, 15 tables, 5 separate plates.

552 *Stack-Unit Geologic Mapping: Color-Coded and Computer-Based Methodology.* 1993. **Berg, R.C., and M.R. Greenpool.** 11 p., 1 figure, 3 tables, 1 plate.

553 *Correlation of the "Boskydell Sandstone" and Other Sandstones Containing Marine Fossils in Southern Illinois Using Palynology of Adjacent Coal Beds.* 1993. **Peppers, R.A.** 18 p., 1 figure.

554 *Availability of Coal Resources for Mining in Illinois, Middletown Quadrangle, Central Illinois.* 1994. **Treworgy, C.G., G.K. Coats, and M.H. Bargh.** 48 p., 41 figures, 5 tables.

556 *Quaternary Geology of the Martinsville Alternative Site, Clark County, Illinois: A Proposed Low Level Radioactive Waste Disposal Site.* 1994. **Curry, B.B., K.G. Troost, and R. Berg.**, 85 p., 46 figures, 6 tables.

Coal Mine Directories and Maps

Coal Mines in Illinois: Athens Quadrangle, Menard and Sangamon Counties. 1994. **Bargh, M.H., and C.A. Chenoweth.** Scale 1:24,000. *Directory of Coal Mines in Illinois, 7.5-Minute Quadrangle Series: Athens Quadrangle, Menard and Sangamon Counties.* 20 p.

Coal Mines in Illinois: Chatham Quadrangle, Sangamon County, Illinois. 1993. **Chenoweth, C.A., M.H. Bargh, and C.G. Treworgy.** Scale 1:24,000. *Directory of Coal Mines in Illinois, 7.5-Minute Quadrangle Series: Chatham Quadrangle, Sangamon County, Illinois.* 15 p.

Coal Mines in Illinois: Oakford Quadrangle, Menard, Cass, and Mason Counties, Illinois. 1993. **Coats, G.K, M.H. Bargh, and C.G. Treworgy.** Scale 1:24,000. *Directory of Coal Mines in Illinois, 7.5-Minute Quadrangle Series: Oakford Quadrangle, Menard, Cass, and Mason Counties, Illinois.* 14 p.

Coal Mines in Illinois: Springfield West Quadrangle, Sangamon County. 1993. **Chenoweth, C.A., M.H. Bargh, and C.G. Treworgy.** Scale 1:24,000. *Directory of Coal Mines in Illinois, 7.5-Minute Quadrangle Series: Springfield West Quadrangle, Sangamon County.* 33 p.

Coal Mines in Illinois: Williamsville Quadrangle, Sangamon, Logan, and Menard Counties. 1994. **Chenoweth, C.A., M.H. Bargh, and C.G. Treworgy.** Scale 1:24,000. *Directory of Coal Mines in Illinois, 7.5-Minute Quadrangle Series: Williamsville Quadrangle, Sangamon, Logan, and Menard Counties.* 16 p.

Environmental Geology

145 *Hydrogeology of the Silurian Dolomite Aquifer in Parts of Northwestern Illinois.* 1993. **Larson, T.L., A.M. Graese, and P.G. Orozco.** 29 p., 16 figures, 2 tables.

146 *Geologic Aspects of a Groundwater Protection Needs Assessment for Woodstock, Illinois: A Case Study.* 1994. **Berg, R.C.** 27 p., 15 figures, 1 separate plate.

Guidebook Series

25 *Waulsortian Mounds and Reservoir Potential of the Ullin Limestone ("Warsaw") in Southern Illinois and Adjacent Areas in Kentucky.* 1994. **Lasemi, Z., J.D. Treworgy, R.D. Norby, J.P. Grube, and B.G. Huff.** 65 p., 42 figures, 1 table, appendix.

Illinois Basin Studies

2 *Gas Potential of the New Albany Shale (Devonian and Mississippian) in the Illinois Basin.* 1994. Hasenmueller, N.R., and J.B. Comer, editors, Illinois Basin Consortium. 83 p., 19 figures, 10 tables, 7 separate plates.

p. 1-4. *Introduction.* Hasenmueller, N.R., J.B. Comer, **W.T. Frankie,** and T. Hamilton-Smith.

p. 5-8. *Data and Methods.* **Frankie, W.T., D.K. Lumm,** W.S. Boberg, J.B. Comer, and T. Hamilton-Smith.

p. 9-12. *Illinois Basin Geologic Setting.* **Lumm, D.K., W.T. Frankie,** N.R. Hasenmueller, and T. Hamilton-Smith.

p. 13-22. *Stratigraphy.* Hasenmueller, N.R., W.S. Boberg, **D.K. Lumm, W.T. Frankie,** T. Hamilton-Smith, and J.B. Comer.

p. 23-40. *Gas Production.* T. Hamilton-Smith, N.R. Hasenmueller, W.S. Boberg, Z. Smidchens, and **W.T. Frankie.**

p. 41-46. *Mineralogy and Geochemistry.* **Frost, J.K.,** and N.R. Shaffer.

p. 47-54. *Source Rock Potential.* Comer, J.B., T. Hamilton-Smith, and **W.T. Frankie.**

Illinois Minerals

111 *Illinois Mineral Industry in 1991 and Review of Preliminary Mineral Production Data for 1992.* 1994. **Samson, I.E.** 42 p., 15 figures, 25 tables.

Illinois Petroleum

139 *Reservoir Characterization and Potential for Improved Oil Recovery within the Aux Vases Formation at Stewardson Field, Shelby County, Illinois.* 1993. **Rice, R.J., R.D. Cole, and S.T. Whitaker.** 36 p., 18 figures, 1 table, 4 plates.

140 *Pressure-Volume-Temperature Correlations for Crude Oils from the Illinois Basin.* 1993. **Sim, S.S.K.** 41 p., 7 figures, 45 tables.

141 *Analysis of the Aux Vases (Mississippian) Petroleum Reservoirs of Energy Field, Williamson County, Illinois.* 1993. **Huff, B.G.** 40 p., 15 figures, 11 plates.

142 *Improved Oil Recovery from the Aux Vases (Mississippian) Formation at Boyd Field, Jefferson County, Illinois.* 1993. **Leetaru, H.E.** 30 p., 20 figures, 1 table.

143 *Strategies for Improved Oil Recovery from Aux Vases Reservoirs in McCreery and McCullum Waterflood Units, Dale Consolidated Field, Franklin County, Illinois.* 1993. **Udegbunam, E.O., D.S. Beaty, and J.P. Fagan, Jr.** 39 p., 29 figures, 6 tables.

Illinois Geologic Quadrangle Map Series

11 *Geologic Map of the Makanda Quadrangle, Jackson and Union Counties, Illinois.* 1993. **Jacobson, R.J., and C.P. Weibel.** Scale 1:24,000.

12 *Geologic Map of the Lick Creek Quadrangle, Johnson, Union, and Williamson Counties, Illinois.* 1993. **Weibel, C.P., and W.J. Nelson.** Scale 1:24,000.

13 *Geologic Map of the Wolf Lake Quadrangle, Jackson and Union Counties, Illinois.* 1993. **Devera, J.A.** Scale 1:24,000.

Open File Series

1993-9a *Generalized Land Surface Topography, Southern Will County.* **Riggs, M.H., R.J. Krumm, C.C. Abert, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9b *Topography of the Bedrock Surface, Southern Will County.* **Abert, C.C., R,J. Krumm, M.H. Riggs, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9c *Thickness of Quaternary Deposits, Southern Will County.* **Abert, C.C., R.J. Krumm, M.H. Riggs, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9d *Cumulative Thickness of Sand and Gravel, Southern Will County.* **Abert, C.C., R.J. Krumm, M.H. Riggs, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9e *Sand Thickness, Southern Will County, Depth Slices 0-50 and 50-100 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9f *Sand Thickness, Southern Will County, Depth Slices 100-150 and 150-200 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9g *Sand Thickness, Southern Will County, Elevation Slices 850-800 and 800-750 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9h *Sand Thickness, Southern Will County, Elevation Slices 750-700 and 700-650 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9i *Sand Thickness, Southern Will County, Elevation Slices 650-600 and 600-550 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

1993-9j *Sand Thickness, Southern Will County, Elevation Slices 550-500 and 500-450 feet.* **Abert, C.C., M.H. Riggs, R.J. Krumm, M.M. McLean, and E.D. McKay.** 1993. Scale 1:100,000. (Computer-generated map)

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